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GSO 214 (1994) (English): INDUSTRIAL SAFETY AND
HEALTH REGULATIONS EQUIPMENT – MATERIALS HANDLING



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GSO 214/1994

اشتراطات السلامة والصحة الصناعية -

الأجهزة - تداول المواد

**INDUSTRIAL SAFETY AND HEALTH
REGULATIONS- EQUIPMENT —
MATERIALS HANDLING**

ICS:13.100

INDUSTRIAL SAFETY AND HEALTH REGULATIONS- EQUIPMENT — MATERIALS HANDLING

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INDUSTRIAL SAFETY AND HEALTH REGULATIONS EQUIPMENT — MATERIALS HANDLING

1. SCOPE AND FIELD OF APPLICATION

This standard is concerned with industrial safety and health regulations - equipment - materials handling. The equipment covered in this standard includes conveyors, powered-industrial trucks, overhead and gantry cranes, crawler locomotive and truck cranes, derricks, slings, helicopters and material hoists.

2. COMPLEMENTARY REFERENCES

- 2.1 GSO 209/1994 "Industrial Safety and Health Regulations - Part 3: Occupational Health and Environmental Control".
- 2.2 GSO 68/1987 "Industrial Safety and Health Regulations - Equipment - Machinery and Guarding - Part 1: General Requirements".
- 2.3 GSO 62/1987 "Industrial Safety and Health Regulations: Hazardous Materials - Flammable and Combustible Liquids - Part 1: Tanks, Piping and Accessories".
- 2.4 GSO 55/1987 "Industrial Safety and Health Regulations: Hazardous Materials - Gases – Part 1: General Requirements".
- 2.5 GSO 78/1987 "Industrial Safety and Health Regulations - Electrical - Part 4: Illumination".
- 2.6 Gulf standard which will be approved by GSO concerned with “Industrial Safety and Health Regulations - Part 4: Hazardous Materials - Toxic and Hazardous Substances”.
- 2.7 GSO 79/1988 "Industrial Safety and Health Regulations - Buildings - Part 1: Building Facilities".

3. DEFINITIONS

- 3.1 D - Designated Units. Units similar to the G units except that they are diesel engine powered instead of gasoline engine powered.
- 3.2 DS - Designated Units. Diesel powered units that are provided with additional safeguards to the exhaust, fuel and electrical systems.
- 3.3 DY - Designated Units. Diesel powered units that have all the safeguards of DS units and in addition do not have any electrical equipment including the ignition and are equipped with temperature limitation features.

- 3.4 E - Designated Units. Electrically powered units that have minimum acceptable safeguards against inherent fire hazards.
- 3.5 ES - Designated Units. Electrically powered units that, in addition to all of the requirements for the E units, are provided within additional safeguards to the electrical system to prevent emission of hazardous sparks and to limit surface temperatures.
- 3.6 EE - Designated Units. Electrically powered units that have, in addition to all of the requirements for the E and ES units, the electric motors and all other electrical equipment completely enclosed.
- 3.7 EX - Designated Units. Electrically powered units that differ from the E, ES, or EE units in that the electrical fittings and equipment are so designed, constructed and assembled that the units may be used in certain atmospheres containing flammable vapors or dusts.
- 3.8 G - Designated Units. Gasoline powered units having minimum acceptable safeguards against inherent fire hazards.
- 3.9 GS - Designated Units. Gasoline powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems.
- 3.10 LP - Designated Units. Similar to the G units except that liquefied petroleum gas is used for fuel instead of gasoline.
- 3.11 LPS - Designated Units. Liquefied petroleum gas powered units that are provided with additional safeguards to the exhaust, fuel, and electrical systems.
- 3.12 Automatic Crane. A crane which when activated operates through a preset cycle or cycles.
- 3.13 Auxiliary Hoist. Supplemental hoisting unit of lighter capacity and usually higher speed than provided for the main hoist.
- 3.14 Bridge. That part of a crane consisting of girders, trucks end ties, footwalks, and drive mechanisms which carry the trolley or trolleys.
- 3.15 Bumper (Buffer). An energy absorbing device for reducing impact when a moving crane or trolley reaches the end of its permitted travel; or when two moving cranes or trolleys come in contact.
- 3.16 Cab-Operated Crane. A crane controlled by an operator in a cab located on the bridge or trolley.
- 3.17 Cantilever Gantry Crane. A gantry or semigantry crane in which the bridge girders or trusses extend transversely beyond the crane runway; on one or both sides.
- 3.18 Control Braking Means. A method of controlling crane motor speed when in an overhauling condition.
- 3.19 Controller, Spring Return. A controller which when released will return automatically to a neutral position.
- 3.20 Countertorque. Method of control by which the power to the motor is reversed to develop torque in the opposite direction.

- 3.21 Crane. A machine for lifting and lowering a load and moving it horizontally, with the hoisting mechanism an integral part of the machine.
- 3.22 Current Collectors. Contacting devices for collecting current from runway or bridge conductors.
- 3.23 Drag Brake. A brake which provides retarding force without external control.
- 3.24 Drift Point. A point on a travel motion controller which releases the brake while the motor is not energized. This allows for coasting before the brake is set.
- 3.25 Dynamic. Method of controlling crane motor speeds when in the overhauling condition to provide a retarding force.
- 3.26 Equalizer. A device which compensates for unequal length or stretch of a rope.
- 3.27 Floor-Operated Crane. A crane which is pendant or nonconductive rope controlled by an operator on the floor or an independent platform.
- 3.28 Gantry Crane. A crane similar to an overhead crane except that the bridge for carrying the trolley or trolleys is rigidly supported on two or more legs running on fixed rails or other runway.
- 3.29 Hoist. An apparatus which may be a part of a crane, exerting a force for lifting or lowering.
- 3.30 Holding Brake. A brake that automatically prevents motion when power is off.
- 3.31 Load Block. The assembly of hook or shackle, swivel, bearing, sheaves, pins, and frame suspended by the hoisting rope.
- 3.32 Man Trolley. A trolley having an operator's cab attached thereto.
- 3.33 Master Switch. A switch which dominates the operation of contactors, relays, or other remotely operated devices.
- 3.34 Mechanical. Method of control by friction.
- 3.35 Overhead Crane. A crane with a movable bridge carrying a movable or fixed hoisting mechanism and traveling on an overhead fixed runway structure.
- 3.36 Regenerative. Form of dynamic braking in which the electrical energy generated is fed back into the power system.
- 3.37 Remote-Operated Crane. A crane controlled by an operator not in a pulpit or in the cab attached to the crane, by any method other than pendant or rope control.
- 3.38 Semigantry Crane. A gantry crane with one end of the bridge rigidly supported on one or more legs that run on a fixed rail or runway, the other end of the bridge being supported by a truck running on an elevated rail or runway.
- 3.39 Side Pull. That portion of the hoist pull acting horizontally when the hoist lines are not operated vertically.
- 3.40 Stop. A device to limit travel of a trolley or crane bridge. This device normally is attached to a fixed structure and normally does not have energy absorbing ability.
- 3.41 Truck. A unit consisting of a frame, wheels, bearings, and axles which supports the bridge girders or trolleys.

- 3.42 Trolley. The unit which travels on the bridge rails and carries the hoisting mechanism.
- 3.43 Wall Crane. A crane having a jib with or without trolley and supported from a side wall or line of columns of a building. It is a traveling type and operates on a runway attached to the side wall or columns.
- 3.44 Angle Indicator (Boom). An accessory which measures the angles of the boom to the horizontal.
- 3.45 Axis of Rotation. The vertical axis around which the crane superstructure rotates.
- 3.46 Boom Angle. The angle between the longitudinal centerline of the boom and the horizontal. The boom longitudinal centreline is a straight line between the boom foot pin (heel pin) centreline and boom point sheave pin centreline.
- 3.47 Boom (Crane). A member hinged to the front of the rotating superstructure with the outer end supported by ropes leading to a gantry or A-frame and used for supporting the hoisting tackle.
- 3.48 Boom Hoist. A hoist drum and rope reeving system used to raise and lower the boom. The rope system may be all live reeving or a combination of live reeving and pendants.
- 3.49 Boom Stop. Device used to limit the angle of the boom at the highest position.
- 3.50 Crawler Crane. Consists of a rotating superstructure with power plant, operating machinery, and boom, mounted on a base, equipped with crawler treads for travel.
- 3.51 Gantry (A-Frame). A structural frame, extending above the superstructure, to which the boom support ropes are reeved.
- 3.52 Jib. An extension attached to the boom point to provide added boom length for lifting specified loads. The jib may be in line with the boom or offset to various angles.
- 3.53 Load Block (Lower). Assembly of hook or shackle, swivel, sheaves, pins and frame suspended by the hoisting ropes.
- 3.54 Load Block (Upper). Assembly of hook or shackle, swivel, sheaves, pins, and frame suspended from the boom point.
- 3.55 Load Hoist. A hoist drum and rope reeving system used for hoisting and lowering loads.
- 3.56 Locomotive Crane. Consists of a rotating superstructure with power plant, operating machinery and boom, mounted on a base or car equipped for travel; on railroad track. It may be self-propelled or propelled by an outside source.
- 3.57 Outriggers. Extendable or fixed metal arms, attached to the mounting base, which rest on supports at the outer ends.
- 3.58 Side Loading. Load applied at an angle to the vertical plane of the boom.
- 3.59 Standing (Guy) Rope. Supporting rope which maintains a constant distance between the points of attachment to the two components connected by the rope.
- 3.60 Superstructure. Rotating upper frame structure of the machine and the operating machinery mounted thereon.

- 3.61 Swing. Rotation of the superstructure for movement of loads in a horizontal direction about the axis of rotation.
- 3.62 Tackle. Assembly of ropes and sheaves arranged for hoisting and pulling.
- 3.63 Truck Crane. Consists of a rotating superstructure with power plant, operating machinery and boom, mounted on an automotive truck equipped with a power plant for travel.
- 3.64 Wheelbase. Distance between centers of front and rear axles. For a multiple axle assembly the axle center for wheelbase measurement is taken as the midpoint of the assembly.
- 3.65 Wheel Mounted Crane (Wagon Crane). Consists of a rotating superstructure with power plant, operating machinery and boom, mounted on a base or platform equipped with axles and rubber-tired wheels for travel. The base is usually propelled by the engine in the superstructure, but it may be equipped with a separate engine controlled from the superstructure.
- 3.66 Whipline (Auxiliary Hoist). Separate hoist rope system of lighter load capacity and higher speed than provided by the main hoist.
- 3.67 Winch Head. Power driven spool for handling of loads by means of friction between fiber or wire rope and spool.
- 3.68 A-Frame Derrick. A derrick in which the boom is hinged from a cross member between the bottom ends of two upright members spread apart at the lower ends and jointed at the top; the boom point secured to the junction of the side members, and the side members are braced or guyed from this junction point. (See Figure 3).
- 3.69 Appointed means. Assigned specific responsibilities by the employer.
- 3.70 Basket-Derrick. A derrick without a boom, similar to a gain pole, with its base supported by ropes attached to corner Posts or other parts of the structure. The base is at a lower elevation than its supports. The location of the base of a basket derrick can be changed by varying the length of the rope supports. The top of the pole is secured with multiple reeved guys to Position the top of the pole to the desired location by varying the length of the upper guy lines. The load is raised and lowered by ropes through a sheave or block secured to the top of the pole. (See Figure 4).
- 3.71 Boom. A timber or metal section or strut, pivoted or hinged at the heel (lower end) at a location fixed in height on a frame or mast or vertical member, and with its point (upper end) supported by chains, ropes, or rods to the upper end of the frame, mast, or vertical member. A rope for raising and lowering the load is reeved through sheaves or a block at the boom point. The length of the boom shall be taken as the straight-line distance between the axis of the foot pin and the axis of the boom point sheave pin, or where used, the axis of the upper load block attachment pin.
- 3.72 Boom Harness. The block and sheave arrangement on the boom point to which the topping lift cable is reeved for lowering and raising the boom.
- 3.73 Boom Point. The outward end of the top section of the boom.

- 3.74 Breast Derrick. A derrick without boom. The mast consists of two side members spread farther apart at the base than at the top and tied together at top and bottom by rigid members. The mast is prevented from tipping forward by guys connected to its top. The load is raised and lowered by ropes through a sheave or block secured to the top crosspiece. (See Figure 4).
- 3.75 Chicago Boom Derrick. A boom which is attached to a structure, an outside upright member of the structure serving as the mast, and the boom being stepped in a fixed socket clamped to the upright. The derrick complete with load, boom, and boom point swing lines falls. (See Figure 4).
- 3.76 Derrick. An apparatus consisting of a mast or equivalent member held at the head by guys or braces, with or without a boom, for use with a hoisting mechanism and operating ropes.
- 3.77 Derrick Bullwheel. A horizontal ring or wheel, fastened to the foot of a derrick, for the purpose of turning the derrick by means of ropes leading from this wheel to a powered drum.
- 3.78 Eye. A loop formed at the end of a rope by securing the dead end to the live end at the base of the loop.
- 3.79 Fiddle Block. A block consisting of two sheaves in the same plane held in place by the same cheek plates.
- 3.80 Foot Bearing or Foot Block (Sill Block). The lower support on which the mast rotates.
- 3.81 Gin Pole Derrick. A derrick without a boom. Its guys are so arranged from its top as to permit leaning the mast in any direction. The load is raised and lowered by ropes reeved through sheaves or blocks at the top of the mast. (See Figure 4).
- 3.82 Gudgeon Pin. A pin connecting the mast cap to the mast allowing rotation of the mast.
- 3.83 Guy. A rope used to steady or secure the mast or other member in the desired position.
- 3.84 Guy Derrick. A fixed derrick consisting of a mast capable of being rotated, supported in a vertical position by guys, and a boom whose bottom end is hinged or pivoted to move in a vertical plane with a reeved rope between the head of the mast and the boom point for raising and lowering the boom, and a reeved rope from the bottom point for raising and lowering the load. (See Figure 3).
- 3.85 Load Block. Lower. The assembly of sheaves, pins, and frame suspended by the hoisting rope.
- 3.86 Load Block, Upper. The assembly of sheaves, pins, and frame suspended from the boom.
- 3.87 Load, Working. The external load, in tons, applied to the derrick, including the weight of load attaching equipment such as load blocks, shackles, and slings.
- 3.88 Mast. The upright member of the derrick.
- 3.89 Mast Cap (Spider). The fitting at the top of the mast to which the guys are connected.

- 3.90 Safety Hook. A hook with a latch to prevent slings or load front accidentally slipping off the hook.
- 3.91 Shearleg Derrick. A derrick without a boom and similar to breast derrick. The mast, wide at the boom and narrow at the top, is hinged at the boom and has its top secured by a multiple reeved guy to permit handling loads at various radii by means of load tackle suspended from the mast top.
- 3.92 Side Loading. A load applied to an angle to the vertical plane of the boom.
- 3.93 Sill. A member connecting the foot block and stiffleg or a member connecting the lower ends of a double member mast.
- 3.94 Standby Derrick. A derrick not in regular service which is used occasionally or intermittently as required.
- 3.95 Stiffleg. A rigid member supporting the mast of the head.
- 3.96 Stiffleg Derrick. A derrick similar to a guy derrick except that the mast is supported or held in place by two or more stiff members, called stifflegs, which are capable of resisting either tensile or compressive forces. Sills are generally provided to connect the lower ends of the stifflegs to the foot of the mast. (See Figure 3).
- 3.97 Swing. Rotation of the mast and/or boom for movements of loads in a horizontal direction about the axis of rotation.
- 3.98 Basket Hitch. A sling configuration whereby the sling is passed under the load and has both ends, end attachments, eyes or handles on the hook or a single master link.
- 3.99 Braided Wire Rope. A wire rope formed by plaiting component wire ropes.
- 3.100 Bridle Wire Rope Sling. A sling composed of multiple wire rope legs with the top ends gathered in a fitting that goes over the lifting hook.
- 3.101 Cable Laid Endless Sling-Mechanical Joint. A wire rope sling made endless by joining the ends of a single length of cable laid rope with one or more metallic fittings.
- 3.102 Cable Laid Grommet-Hand Tucked. An endless wire rope sling made from one length of rope wrapped six times around a core formed by hand tucking the ends of the rope inside the six wraps.
- 3.103 Cable Laid Rope. A wire rope composed of six wire ropes wrapped around a fiber or wire rope core.
- 3.104 Cable Laid Rope Sling-Mechanical Joint. A wire rope sling made from a cable laid rope with eyes fabricated by pressing or swaging one or more metal sleeves over the rope junction.
- 3.105 Choker Hitch. A sling configuration with one end of the sling passing under the load and through an end attachment, handle or eye on the other end of the sling.
- 3.106 Coating. An elastomer or other suitable material applied to a sling to a sling or to a sling component to impart desirable properties.

- 3.107 Designated. An employee selected or assigned by the employer as being qualified to Perform specific duties.
- 3.108 Equivalent Entity. A person or organization (including an employer) which, by possession of equipment, technical knowledge and skills, can perform with equal competence the same repairs and tests as the person or organization with which it is equated.
- 3.109 Fabric. The flexible portion of a metal mesh sling consisting of a series of transverse coils and cross rods. See Figure 6.3-5 and 6.3-6.
- 3.110 Hitch. A sling configuration whereby the sling is fastened to an object or load, either directly to it or around it.
- 3.111 Link. Single ring or chain.
- 3.112 Proof Load. The load applied in performance of a proof test.
- 3.113 Proof Test. A nondestructive tension test performed by the sling manufacturer or an equivalent entity to verify construction and workmanship of a sling.
- 3.114 Rated Capacity or Working Load Limit. The maximum working load permitted by the provisions of this paragraph.
- 3.115 Reach. The effective length of an alloy steel chain sling measured from the top bearing surface of the upper terminal component to the bottom bearing surface of the lower terminal component.
- 3.116 Selvage Edge. The finished edge of synthetic webbing designed to prevent unraveling.
- 3.117 Sling. An assembly which connects the load to the material handling equipment.
- 3.118 Strand Laid Endless Sling-Mechanical Joint. A wire rope sling made endless from one length of rope with the ends jointed by one or more metallic fittings.
- 3.119 Strand Laid Grommet-Hand Tucked. An endless wire rope sling made from one length of strand wrapped 6 times around a core formed by hand tucking ends of the strand inside the 6 wraps.
- 3.120 Strand Laid Rope. A wire rope made with strands (usually 6 or 8) wrapped around a fiber core, wire strand core, or independent wire rope core (WRC).

4. REGULATIONS

4.1 Material Handling

- 4.1.1 General. Clearance signs in Arabic and English to warn of clearance limits shall be provided in accordance with Gulf Standard mentioned in item (2.1).
- 4.1.2 Conveyors
 - 4.1.2.1 Means for stopping the motor or engine shall be provided at the operator's station. Conveyor systems shall be equipped with an audible warning signal to be sounded immediately before starting up the conveyor.
 - 4.1.2.2 If the operator's station is at a remote point, similar provisions for stopping the motor or engine shall be provided at the motor or engine location.

- 4.1.2.3 Emergency stop switches shall be arranged so that the conveyor cannot be started again until the actuating stop switch has been reset to running or “On” position.
- 4.1.2.4 Where a conveyor passes over work areas, aisles, or thoroughfares, guards shall be provided to protect employees required to work below the conveyors from falling materials.
- 4.1.2.5 Conveyors shall be locked out or otherwise rendered inoperable, and tagged with a “Do Not Operate” tag during repairs and when operation is hazardous to employees performing maintenance work.
- 4.1.2.6 All moving parts shall be equipped with guards in accordance with Gulf standard mentioned in item 2.2.
- 4.1.3 Powered - Industrial Trucks
 - 4.1.3.1 General
 - 4.1.3.1.1 All new powered industrial trucks shall meet the design and construction requirements listed in this paragraph.
 - 4.1.3.1.2 It shall be the responsibility of the manufacturers to test all trucks under regulation of governing bodies for stability during tilting, traveling, high lift, lowering, etc. Approved trucks shall bear a label or some other identifying mark in Arabic and English indicating conformance with the governing specifications.
 - 4.1.3.1.3 Modifications and additions which affect capacity and safe operation shall not be performed by the customer or user without manufacturer's prior written approval. Capacity, operation and maintenance instruction, plates, tags, or decals shall be changed accordingly.
 - 4.1.3.1.4 If the truck is equipped with front-end attachments other than factory installed attachments, the user shall request that the truck be marked to identify the attachments and show the approximate weight of the truck and attachment combination at maximum elevation with load laterally centered.
 - 4.1.3.2 Designated Locations
 - 4.1.3.2.1 The atmosphere or location shall have been classified as to whether it is hazardous or nonhazardous prior to the consideration of industrial trucks being used therein and the type of industrial truck required shall be provided as required in the following subparagraphs.
 - 4.1.3.2.2 The industrial trucks specified in Table 1 are the minimum types required.
 - 4.1.3.2.3 For specific areas of use see Table 1 which tabulates the information contained in this subparagraph.
 - 4.1.3.2.4 Power-operated industrial trucks shall not be used in atmospheres containing hazardous concentrations (in explosive limits) of acetylene, butadiene, ethylene oxide, hydrogen (or gases or vapors equivalent in hazard to hydrogen, such as manufactured gas), propylene oxide, acetaldehyde, cyclopropene, diethyl ether, ethylene, isoprene, or unsymmetrical dimethyl hydrazine (UDMH).
 - 4.1.3.2.5 Power-operated industrial trucks shall not be used in atmospheres containing hazardous concentrations of metal dust, including aluminium, magnesium, and their commercial alloys, other metals of similarly hazardous characteristics, or in

atmospheres containing carbon black, coal or coke dust. Approved power-operated industrial trucks designated as EX may be used in such atmospheres.

- 4.1.3.2.6 In atmospheres where dust of magnesium, aluminium or aluminium bronze may be present, fuses, switches, motor controllers, and circuit breakers of trucks shall have enclosures specifically approved by GSMO.
- 4.1.3.2.7 Only approved power-operated industrial trucks designated as EX may be used in atmospheres containing acetone, acrylonitrile, alcohol, ammonia, benzene, benzol, butane, ethylene dichloride, gasoline, hexane, lacquer solvent vapors, naphtha, natural gas, propane, styrene, vinyl acetate, vinyl chloride, or xylenes in quantities sufficient to produce explosive or ignitable mixtures.
- 4.1.3.2.8 Power-operated industrial trucks designated as DY, EE, or EX may be used in locations where flammable liquids or flammable gases are handled, processed or used, but in which the hazardous liquids, vapors or gases will normally be confined within closed containers or closed systems from which they can escape only in case of accidental rupture or breakdown of such containers or systems, or in the case of abnormal operation of equipment;
- also in locations in which hazardous concentrations of gases or vapors are normally prevented by positive mechanical ventilation but which might become hazardous through failure or abnormal operation of the ventilating equipment; or in locations which are adjacent to Class 1, Division 1 locations (see Table 1), and to which hazardous concentrations of gases or vapors might occasionally be communicated unless such communication is prevented by adequate positive-pressure ventilation from a source of clean air, and effective safeguards against ventilation failure are provided.
- 4.1.3.2.9 In locations used for the storage of hazardous liquids in sealed containers or liquefied or compressed gases in containers, approved power-operated industrial trucks designated as DS, ES, GS, or LPS may be used. This classification includes locations where flammable liquids or flammable gases or vapors are used, but which, would become hazardous only in case of an accident or of some unusual operating conditions. Piping without valves, meters and similar devices would not ordinarily be deemed to introduce a hazardous condition even though used for hazardous liquids or gases. Locations used for the storage of hazardous liquids or of liquefied or compressed gases in sealed containers would not normally be considered hazardous unless subject to other hazardous conditions.
- 4.1.3.2.10 Only approved power-operated industrial trucks designated as EX shall be used in atmospheres in which combustible dust is or may be in suspension under normal operating conditions, in quantities sufficient to produce explosive or ignitable mixtures, or where mechanical failure or abnormal operation of machinery or equipment might cause such mixtures to be produced.
- 4.1.3.2.11 Only approved power-operated industrial trucks designated as DY, EE, or EX shall be used in atmospheres in which combustible dust will not normally be in suspension in the air or will not be likely to be thrown into suspension by the normal operation of equipment or apparatus in quantities sufficient to produce explosive or ignitable mixtures but where deposits or accumulations of such dust may be ignited by arcs or sparks originating in the truck.

- 4.1.3.2.12 Only approved power-operated industrial trucks designated as DY, EE, or EX shall be used in locations which are hazardous because of the presence of easily ignitable fibers but in which such fibers are not likely to be in suspension in the air in quantities sufficient to produce ignitable mixtures.
- 4.1.3.2.13 Only approved power-operated industrial trucks designated as DS, DY, ES, EE, EX, GS, or LPS shall be used in locations where easily ignitable fibers are stored or handled, including outside storage, but are not being processed or manufactured.
- 4.1.3.2.14 On piers and wharves handling general cargo, any approved power-operated industrial truck may be used.
- 4.1.3.2.15 In areas classified as hazardous only the approved power-operated industrial trucks specified for such locations in Table 1 shall be used.

Table 1

Summary table on use of industrial trucks in various locations

Classes	Unclassified	Class 1 locations		Class 2 Locations		Class 3 locations			
Description of classes	Locations not possessing atmospheres as described in other columns.	Locations in which flammable gases or vapors are, or may be, present in the air in quantities sufficient to produce explosive or ignitable mixture		Locations which are hazardous because of the presence of combustible dust.		Locations where easily ignitable fibers or flyings are present but not likely to be in suspension in quantities sufficient to produce ignitable mixtures.			
Groups in classes	None	A	B	C	D	E	F	G	None
Examples of locations or atmospheres in classes or groups	Piers and wharves inside and outside general storage general industrial	Acetylene	Hydrogen	Ethylether	Gasoline Naphtha Alcohols Acetone Lacquer Solvent Benzene	Metal	Carbon Black Coal Coke	Grain Flour Starch Organic	Baled waste, cocoa fiber, cotton, excelsior, hemp, istle, jute, kapok, oak, sisal, Spanish moss, synthetic fibers, tow

Table 1 (Continued)

Summary table on use of industrial trucks in various locations

Classes	Unclassified	Class 1 locations		Class 2 locations		Class 3 locations	
		1	2	1	2	1	2
Divisions (Nature of hazardous conditions)	None	Above condition exists continuously, intermittently, or periodically under normal operating conditions.	Above condition may occur accidentally as due to a puncture of a storage drum.	Explosive mixture may be present under normal operating conditions, or where failure of equipment may cause the condition to exist simultaneously with arcing or sparking of electrical equipment, or where dusts of an electrically conducting nature may be present.	Explosive mixture not normally present, but where deposits of dust may cause heat rise in electrical equipment, or where such deposits may be ignited by arcs or sparks from electrical equipment.	Locations in which easily ignitable fibers or materials producing combustible flyings are handled, manufactured, or used.	Locations in which easily ignitable fibers are stored or handled except in the process of manufacture.

Table 1
(continued)

Authorized Use of Trucks by Types in Groups of Classes and Divisions

Groups in Classes	None	A	B	C	D	E	F	G	E	F	G	F	G	None	None
Types of trucks authorized:															
Diesel:															
Type D	D**														
Type DS				DS										DS	
Type DY				DY										DY	
Electric:															
Type E	E**													E	
Type ES				ES										ES	
Type EE				EE										EE	
Type EX				EX										EX	
Gasoline:															
Type G	G**														
Type GS				GS										GS	
LP-Gas:															
Type LP	LP**														
Type LPS				LPS										LPS	

** trucks conforming to these Types may also be used - see subparagraph 4.1.3.2.1.3.

- 4.1.3.3 Safety Guards
 - 4.1.3.3.1 High lift rider trucks shall be fitted with an overhead guard, unless operating conditions do not permit.
 - 4.1.3.3.2 If the type of load presents a hazard, the user shall equip fork trucks with a vertical load back rest extension.
- 4.1.3.4 Fuel Handling and Storage
 - 4.1.3.4.1 The storage and handling of liquid fuels such as gasoline and diesel fuel shall be in accordance with Gulf standard mentioned in 2.3.
 - 4.1.3.4.2 The storage and handling of liquefied petroleum gas fuel shall be in accordance with Gulf standard mentioned in 2.4.
- 4.1.3.5 Changing and Charging Storage Batteries
 - 4.1.3.5.1 Battery charging installations shall be located in areas designated for that purpose.
 - 4.1.3.5.2 Facilities shall be provided for flushing and neutralizing spilled electrolyte, for fire protection, for protecting charging apparatus from damage by trucks, and for ventilation (Ref. GS 209 mentioned in 2.1), for dispersal of fumes from gassing batteries.
 - 4.1.3.5.3 Racks used for support of batteries shall be made of materials nonconductive to spark generation or be coated or covered.
 - 4.1.3.5.4 A conveyor, overhead hoist, or equivalent material handling equipment shall be provided for handling batteries.
 - 4.1.3.5.5 Reinstalled batteries shall be properly positioned and secured in the truck.
 - 4.1.3.5.6 A carboy tilter or siphon shall be provided for handling electrolyte.
 - 4.1.3.5.7 When charging batteries, acid shall be poured into water; water shall not be poured into acid.
 - 4.1.3.5.8 Trucks shall be properly positioned brake applied and ignition off before attempting to change or charge batteries.
 - 4.1.3.5.9 When charging batteries, the vent caps should be kept in place to avoid electrolyte spray. Care shall be taken to assure that vent caps are functioning. The battery (or compartment) cover(s) shall be open to dissipate heat.
 - 4.1.3.5.10 Smoking shall be prohibited in the charging area.
 - 4.1.3.5.11 Precautions shall be taken to prevent open flames sparks, or electric arcs in battery charging areas.
 - 4.1.3.5.12 Tools and other metallic objects shall be kept away from the top of uncovered batteries.
 - 4.1.3.5.13 Face shields, aprons, and rubber gloves shall be worn.
- 4.1.3.6 Lighting for Operating Areas
 - 4.1.3.6.1 Controlled lighting shall be provided in operating areas. (See GS 78 mentioned in 2.5).

- 4.1.3.6.2 Where general lighting is less than 30 lux, auxiliary directional lighting shall be provided on the truck.
- 4.1.3.7 Control of Noxious Gases and Fumes. Concentration levels of carbon monoxide gas created by powered industrial truck operations shall not exceed the levels specified in Gulf standard mentioned in 2.6.
- 4.1.3.8 Trucks and Railroad Cars
- 4.1.3.8.1 The brakes of highway trucks shall be set and wheel chocks placed under the rear wheels to prevent the trucks from rolling while they are boarded.
- 4.1.3.8.2 Wheel stops or other recognized positive protection shall be provided to prevent railroad cars from moving during loading or unloading operations.
- 4.1.3.8.3 Fixed jacks may be necessary to support a semitrailer and prevent upending during the loading or unloading when the trailer is not coupled to a tractor.
- 4.1.3.8.4 Derail and/or bumper blocks shall be provided on spur railroad tracks where a rolling car could contact other cars being worked and enter a building, work or traffic area.
- 4.1.3.9 Operator Training. Only trained and authorized operators shall be permitted to operate a powered industrial truck.
- 4.1.3.10 Operations
- 4.1.3.10.1 Trucks shall not be driven up to anyone standing in front of a bench or other fixed object.
- 4.1.3.10.2 No Person shall be allowed to stand or pass under the elevated portion of any truck, whether loaded or empty.
- 4.1.3.10.3 Unauthorized personnel shall not be permitted to ride trucks. A safe place to ride shall be provided where riding of trucks is authorized.
- 4.1.3.10.4 Arms or legs shall not be placed between the uprights of the mast or outside of the running lines of the truck.
- 4.1.3.10.5 When a truck is left unattended, load engaging means shall be fully lowered, controls shall be neutralized, power shall be shut off, and brakes set. Wheels shall be blocked on downhill side if the truck is parked on an incline.
- A powered industrial truck is unattended when the operator is 7.5 m or more away from the vehicle which remains in his view, or whenever the operator leaves the vehicle and it is not in his view.
- When the operator of an industrial truck is dismounted and within 7.5 m of the truck still in his view, the load engaging means shall be fully lowered, controls neutralized, and the brakes set.
- 4.1.3.10.6 A safe distance of 60 cm shall be maintained from the edge of ramps of platforms while on any elevated dock, or platform or freight car. Trucks shall not be used for opening or closing freight doors.
- 4.1.3.10.7 The flooring of trucks, trailers, and railroad cars shall be checked for breaks and weakness before they are driven into.

- 4.1.3.10.8 There shall be headroom under overhead installations, lights, pipes and sprinkler systems.
- 4.1.3.10.9 An overhead guard shall be used as protection against falling objects. It should be noted that an overhead guard is to offer protection from the impact of small packages, boxes or bagged material, representative of the job application, but not to withstand the impact of a failing capacity load.
- 4.1.3.10.10 Whenever a truck is equipped with vertical only, or vertical and horizontal controls elevatable with the lifting carriage of forks for lifting personnel, the following additional precautions shall be taken for the protection of personnel being elevated:
 - 4.1.3.10.10.1 Use of a safety platform firmly secured to the lifting carriage and/or forks.
 - 4.1.3.10.10.2 Means shall be provided whereby personnel on the platform can shut off power to the truck.
 - 4.1.3.10.10.3 Such protection from falling objects as indicated necessary by the operating conditions shall be provided.
- 4.1.3.11 Traveling
 - 4.1.3.11.1 All traffic regulations shall be observed, including authorized plant speed limits. A safe distance shall be maintained approximately three truck lengths from the truck ahead, and the truck shall be kept under control at all times.
 - 4.1.3.11.2 The right of way shall be yielded to ambulances, fire trucks, or other vehicles in emergency situations.
 - 4.1.3.11.3 Other trucks traveling in the same direction at intersection, blind spots, or other dangerous locations shall not be passed.
 - 4.1.3.11.4 The driver shall be required to slow down and sound the horn at cross aisles and other locations where vision is obstructed. If the load being carried obstructs forward view, the driver shall be required to travel with the load trailing.
 - 4.1.3.11.5 The driver shall be required to look in the direction of, and keep a clear view of the path of travel.
 - 4.1.3.11.6 Grades shall be ascended or descended slowly.
 - When ascending or descending grades in excess of 10 percent, loaded trucks shall be driven with the load upgrade.
 - Unloaded trucks shall be operated on all grades with the load engaging means downgrade.
 - On all grades the load and load engaging means shall be tilted back if applicable, and raised only as far as necessary to clear the road surface.
 - 4.1.3.11.7 Under all travel conditions the truck shall be operated at a speed that will permit it to be brought to a stop in a safe manner.
 - 4.1.3.11.8 Stunt driving and horseplay shall not be permitted.
 - 4.1.3.11.9 The driver shall be required to slow down for wet and slippery floors.

- 4.1.3.11.10 Dockboard or bridgeplates, shall be properly secured before they are driven over. Dockboard or bridgeplates shall be driven over carefully and slowly and their rated capacity never exceeded.
- 4.1.3.11.11 Elevators shall be approached slowly, and then entered squarely after the elevator car is properly leveled. Once on the elevator, the controls shall be neutralized, power shut off. and the brakes set.
- 4.1.3.11.12 Motorized hand trucks must enter elevator or other confined areas with load end forward.
- 4.1.3.11.13 Running over loose objects on the roadway surface shall be avoided.
- 4.1.3.11.14 While negotiating turns, speed shall be reduced to a safe level by means of turning the hand steering wheel in a smooth, sweeping motion. Except when maneuvering at a very low speed, the hand steering wheel shall be turned at a moderate, even rate.
- 4.1.3.11.15 Steering wheel knobs are prohibited.
- 4.1.3.12 Loading
 - 4.1.3.12.1 Only stable or safely arranged loads shall be handled. Caution shall be exercised when handling off-center loads which cannot be centered.
 - 4.1.3.12.2 Only loads within the rated capacity of the truck shall be handled.
 - 4.1.3.12.3 When attachments are used, particular care should be taken in securing, manipulating, positioning, and transporting the load. Trucks equipped with attachments shall be operated as partially loaded trucks when not handling a load.
 - 4.1.3.12.4 A load engaging means shall be placed under the load as far as possible; the mast shall be tilted backward to stabilize the load.
 - 4.1.3.12.5 Extreme care shall be used when tilting the load forward or backward, particularly when high tiering. Tilting forward with load engaging means elevated shall be prohibited except to pick up a load. An elevated load shall not be tilted forward except when the load is in a deposit position over a rack or stack. When stacking or tiering, only enough backward tilt to stabilize the load shall be used.
- 4.1.3.13 Maintenance
 - 4.1.3.13.1 If at any time a powered industrial truck is found to be in need of repair, defective, or in any way unsafe, the truck shall be taken out of service until it has been restored to safe operating condition.
 - 4.1.3.13.2 Fuel tanks shall not be filled while the engine is running and spillage shall be avoided.
 - 4.1.3.13.3 Spillage of oil or fuel shall be carefully washed away or completely evaporated and the fuel tank cap replaced before restarting the engine.
 - 4.1.3.13.4 No truck shall be operated with a leak in the fuel system.
 - 4.1.3.13.5 Open flames shall not be used for checking electrolyte level in storage batteries or gasoline level in fuel tanks.

- 4.1.3.13.6 No repairs shall be made in Class 1, 2 and 3 locations.
- 4.1.3.13.7 Those repairs to the fuel and ignition systems of industrial trucks which involve fire hazards shall be conducted only in locations designated for such repairs.
- 4.1.3.13.8 Trucks in need of repairs to the electrical system shall have the battery disconnected prior to such repairs.
- 4.1.3.13.9 All parts of any such industrial truck requiring replacement shall be replaced only by parts equivalent as to safety with those used in the original design.
- 4.1.3.13.10 Industrial trucks shall be examined before being placed in service, and shall not be placed in service if the examination shows any condition adversely affecting the safety of the vehicle. Such examination shall be made at least daily.
- Where industrial trucks are used on a round-the-clock basis, they shall be examined after each shift. Defects when found shall be immediately reported and corrected. A log book shall be kept noting all inspections and repairs.
- 4.1.3.13.11 Water mufflers shall be filled daily or as frequently as is necessary to prevent depletion of the supply of water below 75 percent of the filled capacity. Vehicles with mufflers having screens or other parts that may become clogged shall not be operated while such screens or parts are clogged. Any vehicle that emits hazardous sparks or flames from the exhaust system shall immediately be removed from service, and not returned to service until the cause for the emission of such sparks and flames has been eliminated.
- 4.1.3.13.12 When the temperature of any part of any truck is found to be in excess of its normal operating temperature. thus creating a hazardous condition, the vehicle shall be removed from service and not returned to service until the cause for such overheating has been eliminated.
- 4.1.3.13.13 Industrial trucks shall be kept in a clean condition, free from lint, excess oil, and grease. Noncombustible agents should be used for cleaning trucks. Low flash point (below 38°C) solvents shall not be used. Precautions regarding toxicity, ventilation, and fire hazard shall be consonant with the agent or solvent used.
- 4.1.3.13.14 Industrial trucks originally approved for the use of gasoline for fuel may be converted to liquefied petroleum gas fuel provided the complete conversion results in a truck which embodies the features specified for LP or LPS designated trucks.
- 4.1.4 Overhead and Gantry Cranes
- 4.1.4.1 General
- 4.1.4.1.1 All overhead and gantry cranes shall meet the design specifications as listed in this paragraph.
- 4.1.4.1.2 Cranes may be modified and rerated provided such modifications and supporting structure are checked thoroughly for the new rated load by a qualified engineer or the equipment manufacturer. The crane shall be tested in accordance with 4.1.4.9.2. New rated load shall be displayed in accordance with 4.1.4.1.4.

- 4.1.4.1.3 Outdoor storage bridges shall be provided with automatic rail clamps. A wind-indicating device shall be provided which will give a visible or audible alarm to the bridge operator at a predetermined wind velocity. Any beads or weld flash on the railheads shall be ground off if the clamps act on the rail heads.
- 4.1.4.1.4 The rated load of the crane shall be plainly marked in Arabic and English on each side of the crane, and if the crane has more than one hoisting unit, each hoist shall have its rated load marked on it or its load block and this marking shall be clearly legible from the ground or floor.
- 4.1.4.1.5 Minimum clearance of 7.5 cm overhead and 5 cm laterally shall be provided and maintained between crane and obstructions. Where passageways or walkways are provided, obstructions shall not be placed so that safety of personnel will be jeopardized by movements of the crane.
- 4.1.4.1.6 If the runways of two cranes are parallel, and there are no intervening walls or structure, there shall be a clearance of 10 cm provided and maintained between the two bridges.
- 4.1.4.1.7 Only designated and qualified personnel shall be permitted to operate a crane.
- 4.1.4.2 Cabs
 - 4.1.4.2.1 The general arrangement of the cab and the location of control and protective equipment shall be such that all operating handles are within convenient reach of the operator when facing the area to be served by the load hook, or while facing the direction of travel of the cab. The arrangement shall allow the operator a full view of the load hook in all positions.
 - 4.1.4.2.2 The cab shall be located to afford a minimum of 7.5 cm clearance from all fixed structures within its area of possible movement.
 - 4.1.4.2.3 The clearance of the cab above the working floor or passageway should be not less than 2 m.
 - 4.1.4.2.4 Access to the cab and/or bridge walkway shall be by a conveniently placed fixed ladder, stairs, or platform requiring no step over any gap exceeding 30 cm. Fixed ladders shall be in conformance with Gulf standard mentioned in item 2.7.
 - 4.1.4.2.5 Necessary clothing and personal belongings shall be stored in such a manner as not to interfere with access or operation.
 - 4.1.4.2.6 Tools, oil cans, waste, extra fuses, and other necessary articles shall be stored in the tool box, and shall not be permitted to lie loose in or about the cab.
 - 4.1.4.2.7 A carbon dioxide, dry-chemical, or equivalent hand fire extinguisher shall be kept in the cab. Carbon tetrachloride extinguishers are prohibited.
 - 4.1.4.2.8 Operators shall be familiar with the operation and care of fire extinguishers.
 - 4.1.4.2.9 Light in the cab shall permit the operator to see clearly enough to perform his work.
- 4.1.4.3 Footwalks and Ladders

- 4.1.4.2.1 A footwalk shall be provided on the drive side along the entire length of the bridge of all cranes having the trolley running on the top of the girders if sufficient headroom is available on cab-operated cranes. To give sufficient access to the opposite side of the trolley, there shall be provided either a footwalk mounted on the trolley, a suitable footwalk or platform in the building, or a footwalk on the opposite side of the crane at least twice the length of the trolley.
- 4.1.4.3.2 Footwalks should be located to give a headroom not less than 2 m. In no case shall less than 1.2 m be provided. If 1.2 m of headroom cannot be provided, footwalks shall be omitted from the crane and a stationary platform or landing stage built for workman making repairs.
- 4.1.4.3.3 Footwalks shall be of rigid construction and designed to sustain a distributed load of at least 250 kg/sq m.
- 4.1.4.3.4 Footwalks shall have a walking surface of antislip type.
- 4.1.4.3.5 Footwalks shall be continuous and permanently secured.
- 4.1.4.3.6 Footwalks should have a clear passageway at least 56 cm wide except opposite the bridge motor, where they should be not less than 38 cm. The inner edge shall extend at least to the line of the outside edge of the lower cover plate or flange of the girder.
- 4.1.4.3.7 Toeboards and hand rails shall be in compliance with Gulf standard mentioned in 2.7.
- 4.1.4.3.8 Gantry cranes shall be provided with ladders or stairways extending from the ground to the footwalk or cab platform.
- 4.1.4.3.9 Stairways shall be equipped with rigid metal handrails. Walking surfaces shall be of an antislip type.
- 4.1.4.3.10 Ladders shall be permanently and securely fastened in place and shall be constructed in compliance with Gulf standard mentioned in 2.7.
- 4.1.4.3.11 Hands shall be free from encumbrances while personnel are using ladders.
- 4.1.4.3.12 Articles which are too large to be carried in pockets or belts shall be lifted and lowered by hand line.
- 4.1.4.4 Stops, Bumpers. Rail Sweeps, and Guards
 - 4.1.4.4.1 Trolley Stops
 - 4.1.4.4.1.1 Stops shall be provided at the limits of travel of the trolley.
 - 4.1.4.4.1.2 Stops shall be fastened to resist all forces applied when contacted.
 - 4.1.4.4.1.3 A stop engaging the tread of the wheel shall be of a height at least equal to the radius of the wheel.
 - 4.1.4.4.2 Bridge Bumpers. A crane shall be provided with bumpers or other automatic stopping means. The bumpers shall be capable of stopping the crane (not including the lifted load) at an average rate of deceleration not to exceed 0.9 m/sec/sec., when travelling in either direction at 20 percent of rated load speed.

- 4.1.4.4.2.1 The bumpers shall have sufficient energy absorbing capacity to stop the crane when traveling at a speed of at least 40 percent of rated load speed.
- 4.1.4.4.2.2 The bumper shall be so mounted that there is no direct shear on bolts.
- 4.1.4.4.2.3 Bumpers shall be so designed and installed as to minimize parts falling from the crane in case of breakage.
- 4.1.4.4.3 Trolley Bumpers
 - 4.1.4.4.3.1 A trolley shall be provided with bumpers or other automatic means of equivalent effect, unless the trolley travels at a slow rate of speed, or is not operated near the ends of the bridge and trolley travel, or is restricted to a limited distance of the runway and there is no hazard of striking any object in this limited distance, or is used in similar operating conditions. The bumpers shall be capable of stopping the trolley (not including the lifted load) at an average rate of deceleration not to exceed 1.5 m/sec/sec., when traveling in either direction at one-third of the rated load speed.
 - 4.1.4.4.3.2 When more than one trolley is operated on the same bridge, each shall be equipped with bumpers or other equivalent means on their adjacent ends.
 - 4.1.4.4.3.3 Bumpers or other equivalent means shall be designed and installed to minimize parts falling from the trolley in case of breakage.
- 4.1.4.4.4 Bridge trucks shall be equipped with sweeps which extend below the top of the rail and project in front of the truck wheels.
- 4.1.4.4.5 Guards for Hoisting Ropes
 - 4.1.4.4.5.1 If fouling or chafing of hoisting ropes is possible, guards shall be installed to prevent this condition.
 - 4.1.4.4.5.2 A guard shall be provided to prevent contact between bridge conductors and hoisting ropes.
- 4.1.4.4.6 Guards for Moving Parts
 - 4.1.4.4.6.1 Exposed moving parts such as gears, set screws, projecting keys, chains, chain sprockets, and reciprocating components shall be guarded.
 - 4.1.4.4.6.2 Guards shall be securely fastened in place.
 - 4.1.4.4.6.3 Each guard shall be capable of supporting without permanent distortion the weight of a 90 kg person unless the guard is located where it is impossible for a person to step on it.
- 4.1.4.5 Brakes
 - 4.1.4.5.1 Each independent hoisting unit of a crane shall be equipped with at least one self-setting brake, hereafter referred to as holding brake, applied directly to the motor shaft or some part of the gear train.
 - 4.1.4.5.2 Each independent hoisting unit of a crane, except worm-gear hoists whose worm angle is such as to prevent the load from accelerating in the lowering direction shall, in addition to a holding brake, be equipped with control braking means to prevent overspeeding.

- 4.1.4.5.3 Holding brakes for hoist motors shall have not less than the following percentage of the full load hoisting torque at the point where the brake is applied:
 - 4.1.4.5.3.1 125 percent when used with control braking means other than mechanical;
 - 4.1.4.5.3.2 100 percent when used in conjunction with a mechanical control braking means;
 - 4.1.4.5.3.3 100 percent each if two holding brakes are provided.
- 4.1.4.5.4 Holding brakes on hoists shall have ample thermal capacity for the frequency of operation required by the service.
- 4.1.4.5.5 Holding brakes on hoists shall be applied automatically when power is removed.
- 4.1.4.5.6 Where necessary, holding brakes shall be provided with adjustment means to compensate for wear.
- 4.1.4.5.7 The wearing surface of all holding-brake drums or discs shall be smooth. Each independent hoisting unit of a crane handling hot metal and having power control braking means shall be equipped with at least two holding brakes.
- 4.1.4.5.8 A power control braking means such as regenerative, dynamic or countertorque braking, or a mechanically controlled braking means shall be capable of maintaining safe lowering speeds of rated loads. The control braking means shall have ample thermal capacity for the frequency of operation required by service.
- 4.1.4.5.9 Foot operated brakes shall not require an applied force of more than 30 kg to develop manufacturer's rated brake torque.
- 4.1.4.5.10 Brakes may be applied by mechanical, electrical, pneumatic, hydraulic, or gravity means.
- 4.1.4.5.11 Where necessary, brakes shall be provided with adjustment means to compensate for wear.
- 4.1.4.5.12 The wearing surface of all brakedrums or discs shall be smooth.
- 4.1.4.5.13 All foot-brake pedals shall be constructed so that the operator's foot will not easily slip off the pedal.
- 4.1.4.5.14 Foot-operated brakes shall be equipped with automatic means for positive release when pressure is released from the pedal.
- 4.1.4.5.15 Brakes for stopping the motion of the trolley or bridge shall be of sufficient size to stop the trolley or bridge within a distance in meters equal to 10 percent of full load speed in m/min. when traveling at full speed with full load.
- 4.1.4.5.16 If holding brakes are provided on the bridge or trolleys, they shall not prohibit the use of a drift point in the control circuit.
- 4.1.4.5.17 Brakes on trolleys and bridges shall have ample thermal capacity for the frequency of operation required by the service to prevent impairment of functions from overheating.

- 4.1.4.5.18 On cab-operated cranes with cab on trolley, a trolley brake shall be required. A drag brake may be applied to hold the trolley in a desired position on the bridge and to eliminate creep with the power off.
- 4.1.4.5.19 On cab-operated cranes with cab on bridge, a bridge brake is required.
- 4.1.4.5.20 On cab-operated cranes with cab on trolley, a bridge brake of the holding type shall be required.
- 4.1.4.5.21 On all floor, remote and pulpit-operated crane bridge drives, a brake or non-coasting mechanical drive shall be provided.
- 4.1.4.6 Electric Equipment
 - 4.1.4.6.1 Wiring and equipment shall comply with Section 7.0.
 - 4.1.4.6.1.1 The control circuit voltage shall not exceed 600 volts for A.C. or D.C. current.
 - 4.1.4.6.1.2 The voltage at pendant pushbuttons shall not exceed 150 volts for A.C. and 300 volts for D.C.
 - 4.1.4.6.1.3 Where multiple conductor cable is used with a suspended pushbutton station, the station must be supported in some satisfactory manner that will protect the electrical conductors against strain.
 - 4.1.4.6.1.4 Pendant control boxes shall be constructed to prevent electrical shock and shall be clearly marked for identification of functions.
 - 4.1.4.6.2 Equipment
 - 4.1.4.6.2.1 Electrical equipment shall be so located or enclosed that live parts will not be exposed to accidental contact under normal operating conditions.
 - 4.1.4.6.2.2 Electric equipment shall be protected from dirt, grease, oil and moisture.
 - 4.1.4.6.2.3 Guards for live parts shall be substantial and so located that they cannot be accidentally deformed so as to make contact with the live parts.
 - 4.1.4.6.3 Controllers
 - 4.1.4.6.3.1 Cranes not equipped with spring-return controllers or momentary contact pushbuttons shall be provided with a device which will disconnect all motors from the line on failure of power and will permit any motor to be restarted until the controller handle is brought to the "off" position, or a reset switch or button is operated.
 - 4.1.4.6.3.2 Lever, operated controllers shall be provided with a notch or latch which in the "Off" position prevents the handle from being inadvertently moved to the "On" position. An "Off" detent or spring return arrangement is acceptable.
 - 4.1.4.6.3.3 The controller operating handle shall be located within convenient reach of the operator.
 - 4.1.4.6.3.4 As far as practicable, the movement of each controller handle shall be in the same general directions as the resultant movements of the load.
 - 4.1.4.6.3.5 The control for the bridge and trolley travel shall be so located that the operator can readily face the direction of travel.

- 4.1.4.6.3.6 For floor-operated cranes, the controller or controllers if rope operated, shall automatically return to the “off” position when released by the operator.
- 4.1.4.6.3.7 Pushbuttons in pendant stations shall return to the “off” position when pressure is released by the crane operator.
- 4.1.4.6.3.8 Automatic cranes shall be so designed that all motions shall fail-safe if any malfunction of operation occurs.
- 4.1.4.6.3.9 Remote-operated cranes shall function so that if the control signal for any crane motion become ineffective the crane motion shall stop.
- 4.1.4.6.4 Resistors
- 4.1.4.6.4.1 Enclosures for resistors shall have openings to provide ventilation, and shall be installed to prevent the accumulation of combustible matter near hot parts.
- 4.1.4.6.4.2 Resistor units shall be supported so as to be as free from vibration as possible.
- 4.1.4.6.4.3 Provision shall be made to prevent broken parts of molten metal falling upon the operator or from the crane.
- 4.1.4.6.5 Switches
- 4.1.4.6.5.1 The power supply to the runway conductors shall be controlled by a switch or circuit breaker located on a fixed structure, accessible from the floor, and arranged to be locked in the open position.
- 4.1.4.6.5.2 On cab-operated cranes a switch or circuit breaker of the enclosed type. with provision for locking in the open position, shall be provided in the leads from the runway conductors. A means of opening this switch or circuit breaker shall be located within easy reach of the operator.
- 4.1.4.6.5.3 On floor-operated cranes, a switch or circuit braker of the enclosed type with provision for locking in the open position, shall be provided in the leads from the runway conductors. This disconnect shall be mounted on the bridge or footwalk near the runway collectors. One of the following types of floor-operated disconnects shall be provided:
- Non-conductive rope attached to the main disconnect switch;
 - An undervoltage trip for the main circuit breaker operated by an emergency stop button in the pendant pushbutton station;
 - A main line contactor operated by a switch or pushbutton in the pendant pushbutton station.
- 4.1.4.6.5.4 The hoisting motion of all electric traveling cranes shall be provided with an overtravel limit switch in the hoisting direction.
- 4.1.4.6.5.5 All cranes using a lifting magnet shall have a magnetic circuit switch of the enclosed type with provision for locking in the open position. Means for discharging the inductive load of the magnet shall be provided.
- 4.1.4.6.6 Conductors of the open type mounted on the crane runway begins or overhead shall be so located or so guarded that persons entering or leaving the cab or crane footwalk normally could not come into contact with them.

- 4.1.4.6.7 If a service receptacle is provided in the cab or on the bridge of cab-operated cranes, it shall be a grounded three-prong type permanent receptacle, not exceeding 300 volts.
- 4.1.4.7 Hoisting Equipment
 - 4.1.4.7.1 Sheave grooves shall be smooth and free from surface defects which could cause rope damage .
 - 4.1.4.7.2 Sheaves carrying ropes which can be momentarily unloaded shall be provided with closefitting guards or other suitable devices to guide the rope back into the groove when the load is applied again.
 - 4.1.4.7.3 The sheaves in the bottom block shall be equipped with close-fitting guards that will prevent ropes from becoming fouled when the block is lying on the ground with ropes loose.
 - 4.1.4.7.4 Pockets and flanges of sheaves used with hoist chains shall be of such dimensions that the chain does not catch or bind during operation.
 - 4.1.4.7.5 All running sheaves shall be equipped with means for lubrication. Permanently lubricated, sealed and/or shielded bearings meet this requirement.
 - 4.1.4.7.6 The rated load divided by the number of parts of rope shall not exceed 20 percent of the nominal breaking strength of the rope.
 - 4.1.4.7.7 The rope shall be secured to the drum as follows:
 - 4.1.4.7.7.1 No less than two wraps of rope shall remain on the drum when the hook is in its extreme low position.
 - 4.1.4.7.7.2 Rope end shall be anchored by a clamp securely attached to the drum, or by a socket arrangement approved by the crane or rope manufacturer.
 - 4.1.4.7.8 Rope clips attached with U-bolts shall have the U-bolts on the dead or short end of the rope. Clips shall be drop-forged steel in all sizes manufactured commercially. When a newly installed rope has been in operation for an hour, all nuts on the clip bolts shall be retightened.
 - 4.1.4.7.9 Wherever exposed to temperatures, at which fiber cores would be damaged, rope having an independent wire-rope or wire-strand core. or other temperature-damage resistant core shall be used.
 - 4.1.4.7.10 If a load is supported by more than one part of rope, tension in the parts shall be equalized.
- 4.1.4.8 Warning Device

Except for floor-operated cranes a gong or other effective warning signal shall be provided for each crane equipped with a power traveling mechanism.
- 4.1.4.9 Inspection
 - 4.1.4.9.1 Prior to initial use all new and altered cranes shall be inspected to insure compliance with the provisions of this subparagraph. Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the crane and the

degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as "Frequent" and "Periodic" with respective intervals between inspections as defined below:

4.1.4.9.1.1 Frequent inspection --- Daily to monthly intervals.

4.1.4.9.1.2 Periodic inspection --- 1 to 12 - month intervals.

4.1.4.9.2 The following items shall be inspected for defects at intervals as defined in 4.1.4.9.1.1 as specifically indicated, including observation during operation for any defects which might appear between regular inspections. All deficiencies such as listed shall be carefully examined and determination made as to whether they constitute a safety hazard:

- All functional operating mechanisms for maladjustment interfering with proper operation Daily.
- Deterioration or leakage in lines, tanks, Valves, drain pumps, and other parts of air or hydraulic systems. Daily.
- Hooks with deformation or cracks. Visual inspection daily; monthly inspection with signed report. Hooks with cracks or deformations are prohibited and shall be replaced.
- Hoist chains, including end connections, for excessive wear, twist, distorted links interfering with proper function, or stretch beyond manufacturer's recommendations. Visual inspection daily; monthly inspection with signed report.
- All functional operating mechanisms for excessive wear of components.

4.1.4.9.3 Complete inspections of the crane shall be performed at intervals defined in 4.1.4.9.1.2. These inspections shall include the requirements of 4.1.4.9.2 and in addition, the following items. Any deficiencies such as listed shall be carefully examined and corrected if faulty.

Deformed, cracked, or corroded members.

Loose bolts or rivets,

Cracked or worn out sheaves and drums are prohibited and shall be replaced.

Worn out, cracked or distorted parts such as pins, bearings, shafts, gears, rollers, locking and clamping devices shall be removed and replaced.

Excessive wear on brake system parts, linings, pawls, and ratchets.

Load, wind, and other indicators over their full range, for any significant inaccuracies.

Gasoline, diesel, electric, or other powerplants for improper performance or noncompliance with applicable safety requirements.

Excessive wear of chain drive sprockets and excessive chain stretch.

Crane hooks. Magnetic particle or other suitable crack detecting inspection should be performed at least once each year.

- Electrical apparatus, for signs of pitting or any deterioration of controller contactors, limit switches and pushbuttons stations.
- 4.1.4.9.4 A crane which has been idle for a period of one month or more, but less than 6 months, shall be given an inspection conforming with requirements of 4.1.4.9.2 and 6.3.5.14.2 before placing in service.
- 4.1.4.9.5 A crane which has been idle for a period of over 6 months shall be given a complete inspection conforming with requirements of items 4.1.4.9.2, 4.1.4.9.3 and 6.3.5.14.2 before placing in service.
- 4.1.4.9.6 Standby cranes shall be inspected at least semi-annually in accordance with requirements of items 4.1.4.9.2 and 6.3.5.14.2. Standby cranes exposed to adverse environment should be inspected more frequently.
- 4.1.4.10 Testing
- 4.1.4.10.1 Prior to initial use all new and altered cranes shall be tested to insure compliance with this paragraph including the following functions:
- Hoisting and lowering.
- Trolley travel.
- Bridge travel.
- Limit switches, locks and safety devices.
- 4.1.4.10.2 The trip setting of hoist limit switches shall be determined by tests with an empty hook traveling in increasing speeds up to the maximum speed. The actuating mechanism of the limit switch shall be located so that it will trip the switch, under all conditions, in sufficient time to prevent contact of the hook or hook block with any part of the trolley.
- 4.1.4.10.3 Prior to initial use all new, extensively repaired, and altered cranes should be tested by or under the direction of an appointed or authorized person, confirming the load rating of the crane. The load rating should not be more than 80 percent of the maximum load sustained during the test. Test loads shall not be more than 125 percent of the rated load unless otherwise recommended by the manufacturer. The test reports shall be placed or filed to be readily available to appointed personnel.
- 4.1.4.11 Maintenance
- 4.1.4.11.1 A preventive maintenance program based on the crane manufacturer's recommendations shall be established.
- 4.1.4.11.2 Before adjustments and repairs are started on a crane the following precautions shall be taken:
- 4.1.4.11.2.1 The crane to be repaired shall be run to a location where it will cause the least interference with other cranes and operations in the area.
- 4.1.4.11.2.2 All controllers shall be at the "Off" position.
- 4.1.4.11.2.3 The main or emergency switch shall be open and locked in the open position.
- 4.1.4.11.2.4 Warning or "Out of order" signs shall be placed on the crane, also on the floor beneath or on the hook where visible from the floor.

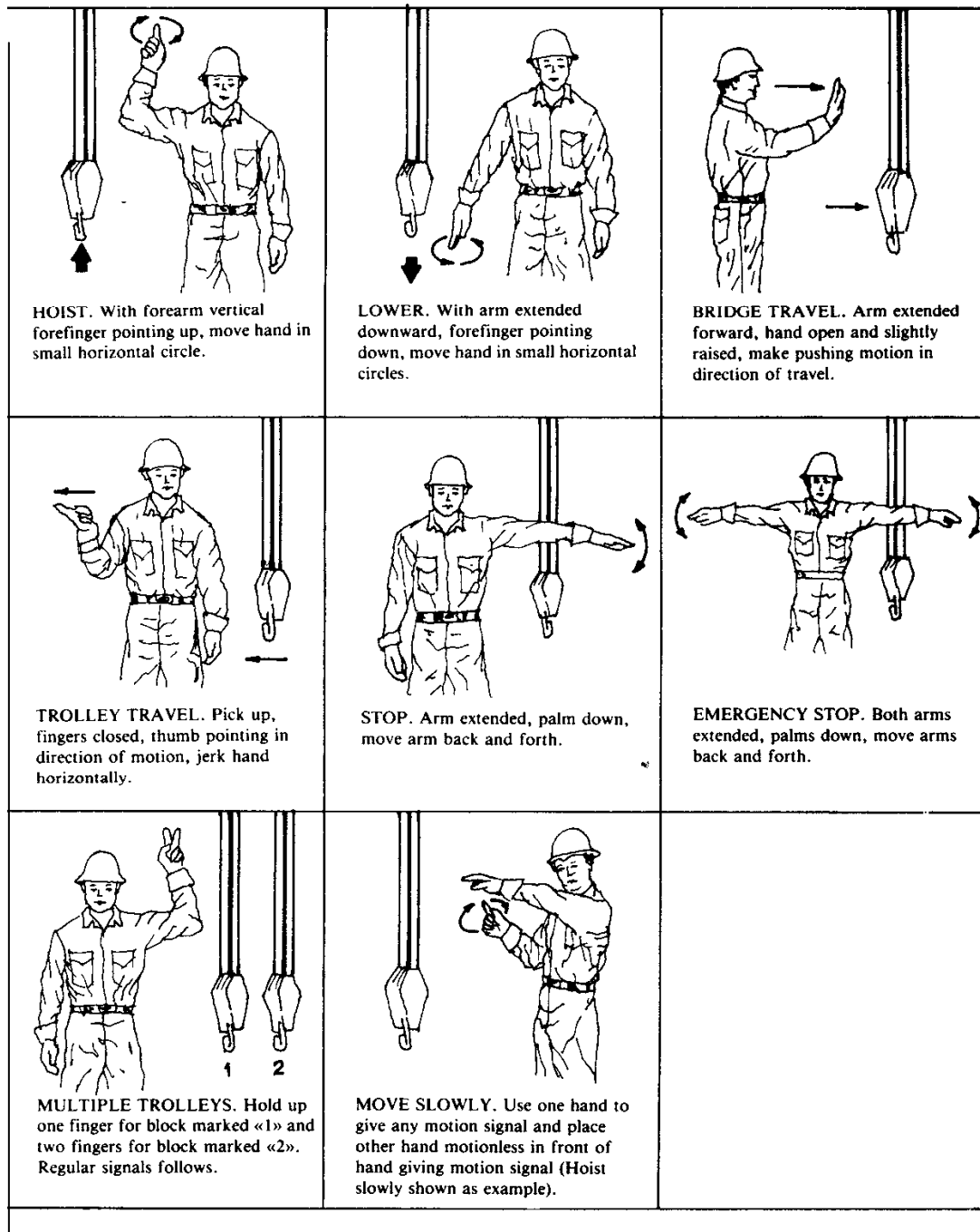
- 4.1.4.11.2.5 Where other cranes are in operation on the same runway, rail stops or other suitable means shall be provided to prevent interference with the idle crane.
- 4.1.4.11.2.6 Where temporary protective rail stops are not available, or practical, a signalman should be placed at a visual vantage point for observing the approach of an active crane and warning its operator when reaching the limit of safe distance from the idle crane.
- 4.1.4.11.2.7 After adjustments and repairs have been made the crane shall not be operated until all guards have been reinstalled, safety devices reactivated and maintenance equipment removed.
- 4.1.4.11.3 Any unsafe conditions disclosed by the inspections requirements of 4.1.4.9 shall be corrected before operation of the crane is resumed. Adjustments and repairs shall be done by only designated and qualified personnel.
- 4.1.4.11.4 Adjustments shall be maintained to assure correct functioning of components. The following are examples:
- All functional operating mechanisms.
 - Limit switches.
 - Control systems.
 - Brakes.
 - Power plants.
- 4.1.4.11.5 Repairs or replacements shall be provided promptly as needed for safe operation.
- 4.1.4.12 Rope Inspection
- 4.1.4.12.1 A thorough inspection of all ropes shall be made at least once a month and full written, dated and signed report of rope condition kept on file will be readily available to appointed personnel. Any deterioration or damage such as described below, shall prohibit the further use of the rope:
- 4.1.4.12.1.1 Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wire.
- 4.1.4.12.1.2 A number of broken outside wires and the degree of distribution or concentration of such broken wires.
- 4.1.4.12.1.3 Worn outside wires.
- 4.1.4.12.1.4 Corroded or broken wires at end connections.
- 4.1.4.12.1.5 Corroded, cracked, bent, worn out, or improperly applied end connections.
- 4.1.4.12.1.6 Severe kinking, crushing, cutting, or unstranding. .
- 4.1.4.12.2 All the rope which has been idle for a period of a month or more due to shutdown or storage of a crane on which it is installed shall be given a thorough inspection before it is placed in service. This inspection shall be for all types of deterioration and shall be performed by an appointed person whose approval shall be required for further use of the rope. A written and dated report of the rope condition shall be available for inspection.
- 4.1.4.13 Handling the Load

- 4.1.4.13.1 The crane shall not be loaded beyond its rated load except for test purposes as provided in 4.1.4.10.3.
- 4.1.4.13.2 The hoist chain or hoist rope shall be free from kinks or twists and shall not be wrapped around the load. The load shall be attached to the load block hook by means of slings. Care shall be taken to make certain that the sling clears all obstacles.
- 4.1.4.13.3 The load shall be well secured and Properly balanced in the sling or lifting device before it is lifted more than a few cm.
- 4.1.4.13.4 Before starting to hoist, the following conditions shall be noted:
 - 4.1.4.13.4.1 Hoist rope shall not be kinked.
 - 4.1.4.13.4.2 Multiple part lines shall not be twisted around each other.
 - 4.1.4.13.4.3 The hook shall be brought over the load in such a manner as to prevent swinging.
- 4.1.4.13.5 During hoisting, care shall be taken that:
 - 4.1.4.13.5.1 There is not sudden acceleration or deceleration of the moving load.
 - 4.1.4.13.5.2 The load does not contact any obstructions.
- 4.1.4.13.6 Cranes shall not be used for side pulls except when specifically authorized by a responsible person who has determined that the stability of the crane is not thereby endangered and that various parts of the crane will not be overstressed.
- 4.1.4.13.7 While any employee is on the load or hook, there shall be no hoisting, lowering or traveling.
- 4.1.4.13.8 Carrying loads over people shall be prohibited.
- 4.1.4.13.9 The operator shall test the brakes each time a load approaching the rated load is handled. The brakes shall be tested by raising the load a few cm and applying the brakes.
- 4.1.4.13.10 The load shall not be lowered below the point where less than two full wraps of rope remain the hoisting drum.
- 4.1.4.13.11 When two or more cranes are used to lift a load one qualified responsible person shall be in charge of the operation. He shall analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.
- 4.1.4.13.12 The operator shall not leave his position at the controls while the load is suspended.
- 4.1.4.13.13 The warning signal shall be sounded when starting the bridge or when the load or hook approaches near or or over personnel.
- 4.1.4.13.14 See figure (1) for standard hand signals for communication between crane operator and hook handler.
- 4.1.4.13.15 At the beginning of each operator's shift, the upper limit switch of each hoist shall be tried out under no load. Extreme care shall be exercised; the block shall be moved at intermittent motion into the limit or run in at slow speed. If the switch does not operate properly, the appointed person shall be immediately notified.

- 4.1.4.13.16 The hoist limit switch which controls the upper limit of travel of the load block shall never be used as an operating control.

Figure (1)

**Standard Hand Signals
for Overhead and Gantry Cranes**



- 4.1.5 Crawler, Locomotive and Truck Cranes
- 4.1.5.1 General. All crawler, locomotive, and truck cranes shall meet the design specifications as listed in this subparagraph.
- 4.1.5.1.1 Only designated and qualified personnel shall be permitted to operate a crane covered by this paragraph.
- 4.1.5.1.2 A substantial and durable rating chart with clearly legible letters and figures in Arabic and English shall be provided with each crane and securely fixed to the crane cab in a location easily visible to the operator while seated at his control station.
- 4.1.5.2 Inspection Classification
- 4.1.5.2.1 Prior to, initial use all new and altered cranes shall be inspected to insure compliance with provisions of this subparagraph.
- 4.1.5.2.2 Inspection procedure for cranes in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the crane and the degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as "frequent" or "Periodic", with respective intervals between inspections as defined below:
- Frequent inspection: Daily to monthly intervals.
 - Periodic inspection: 1 to 12 - month intervals, or as specifically recommended by the manufacturer.
- 4.1.5.2.3 Items such as the following shall be inspected for defects at intervals as defined in 4.1.5.2.2 or as specifically indicated including observation during operation for any defects which might appear between regular inspections. Any deficiencies such as listed shall be carefully examined and corrected if faulty.
- 4.1.5.2.3.1 All control mechanisms for maladjustment interfering with proper operation: Daily.
- 4.1.5.2.3.2 All control mechanisms for excessive wear of components and contamination by lubricants or other foreign matter.
- 4.1.5.2.3.3 All safety devices for malfunction.
- 4.1.5.2.3.4 Deterioration or leakage in air or hydraulic systems: Daily.
- 4.1.5.2.3.5 Use of crane hooks with deformations or cracks are prohibited and shall be replaced.
- 4.1.5.2.3.6 Rope reeving for noncompliance with manufacturers recommendations.
- 4.1.5.2.3.7 Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.
- 4.1.5.2.4 Complete inspections of the crane shall be performed at intervals as generally defined in 4.1.5.2.2. These inspections shall include the requirements of 4.1.5.2.3 and in addition, items such as the following; (Any deficiencies such as listed shall be carefully examined and corrected if faulty):

- 4.1.5.2.4.1 Deformed, cracked, or corroded members in the crane structure and boom.
 - 4.1.5.2.4.2 Loose bolts or rivets.
 - 4.1.5.2.4.3 Cracked or worn out sheaves and drums are prohibited and shall be replaced.
 - 4.1.5.2.4.4 Worn out, cracked, or distorted parts such as pins, bearings, shafts, gears, rollers, and locking devices shall be removed and replaced.
 - 4.1.5.2.4.5- Excessive wear on brake and clutch system parts, linings, pawls, and ratchets.
 - 4.1.5.2.4.6 Load, boom angle, and other indicators over their full range, for any significant inaccuracies.
 - 4.1.5.2.4.7 Gasoline, diesel, electric, or other power plants for improper performance or noncompliance with safety requirements.
 - 4.1.5.2.4.8 Excessive wear of chain-drive sprockets and excessive chain stretch.
 - 4.1.5.2.4.9 Travel steering, braking, and locking devices, for malfunction.
 - 4.1.5.2.4.10 Excessively worn or damaged tires.
 - 4.1.5.2.5 A crane which has been idle for a period of one month or more, but less than 6 months, shall be given an inspection conforming with requirements of items 4.1.5.2.3 and 4.1.5.5.3 before placing in service.
 - 4.1.5.2.6 A crane which has been idle for a period of six months shall be given a complete inspection conforming with requirements of items 4.1.5.2.3, 4.1.5.2.4 and 4.1.5.5.3 before placing in service.
 - 4.1.5.2.7 Standby cranes shall be inspected at least semi-annually in accordance with requirements of items 4.1.5.2.3 and 4.1.5.5.3.
 - 4.1.5.2.8 Written, dated, and signed inspection reports and records shall be made monthly on critical items in use such as brakes, crane hooks, ropes. Records shall be kept readily available.
 - 4.1.5.3 Testing
 - 4.1.5.3.1 In addition to prototype tests and quality-control measures, each new production crane shall be tested by the manufacturer to the extent necessary to insure compliance with the operational requirements of this subparagraph including functions such as the following:
 - Load hoisting and lowering mechanisms.
 - Eloom hoisting and lowering mechanisms.
 - Swinging mechanism.
 - Travel mechanism.
 - Safety devices.
- Where the complete production crane is not supplied by one manufacturer such tests shall be conducted at final assembly.
- Certified production-crane test results shall be made by the manufacturer and supplied to the purchaser.

- 4.1.5.3.2 Written reports shall be available showing test procedures and confirming the adequacy of repairs or alterations.
- 4.1.5.3.3 Test loads shall not exceed 110 percent of the rated load at any selected working radius.
- 4.1.5.3.4 Where rerating is necessary: Crawler locomotive truck, and wheel-mounted cranes shall be tested by the manufacturer. Rerating test report shall be readily available.
- 4.1.5.3.5 No cranes shall be rerated in excess of the original load ratings unless such ratings changes are approved by the crane manufacturer.
- 4.1.5.4 Maintenance Procedure, General. After adjustments and repairs have been made the crane shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.
- 4.1.5.5 Rope Inspection
 - 4.1.5.5.1 A thorough inspection of all ropes in use shall be made at least once a month and a full written, dated, and signed report of the rope condition kept on file where readily available. All inspections shall be performed by an appointed or authorized person. Any deterioration or damage such as described below shall prohibit the further use of the rope:
 - 4.1.5.5.1.1 Reduction of rope diameter below nominal diameter due to, loss of core support, internal or external corrosion, or wear of outside wires.
 - 4.1.5.5.1.2 A number of broken outside wires and the degree distribution of concentration of such broken wires.
 - 4.1.5.5.1.3 Worn outside wires.
 - 4.1.5.5.1.4 Corroded or broken wires at end connections.
 - 4.1.5.5.1.5 Corroded, cracked, bent, worn out, or improperly applied end connections.
 - 4.1.5.5.1.6 Severe kinking, crushing, cutting, or unstranding.
 - 4.1.5.5.2 Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Particular care shall be taken to inspect ropes at these locations.
 - 4.1.5.5.3 All the rope which has been idle for a period of a month or more due to shut down or storage of a crane on which it is installed shall be given a thorough inspection before it is placed in service. This inspection shall be for all types of deterioration and shall be performed by an appointed or authorized person whose approval shall be required for further use of the rope. A written and dated report of the rope condition shall be available.
 - 4.1.5.5.4 Particular care shall be taken in the inspection of nonrotating rope.
- 4.1.5.6 Operation
 - 4.1.5.6.1 No crane shall be loaded beyond the rated load, except for test purposes as provided in 4.1.5.3.

When loads which are limited by structural competence rather than by stability are to be handled, it shall be ascertained that the weight of the load has been determined within ± 10 percent before it is lifted.

- 4.1.5.6.2 The hoist rope shall not be wrapped around the load. The load shall be attached to the hook by means of slings.
- 4.1.5.6.3 The operator shall assure that:
 - 4.1.5.6.3.1 The crane is level, where necessary blocked properly and outriggers shall be used when supplied.
 - 4.1.5.6.3.2 The load is well secured and properly balanced in the sling or lifting device before it is lifted more than a few cm.
- 4.1.5.6.4 Before starting to hoist, the following conditions shall be noted:
 - 4.1.5.6.4.1 Hoist rope shall not be kinked.
 - 4.1.5.6.4.2 Multiple part lines shall not be twisted around each other.
 - 4.1.5.6.4.3 The hook shall be brought over the load in such a manner as to prevent swinging.
 - 4.1.5.6.4.4 If there is a slack rope condition, it should be determined that the rope is properly seated on the drum and in the sheaves.
- 4.1.5.6.5 During hoisting care shall be taken that:
 - 4.1.5.6.5.1 There is no sudden acceleration or deceleration of the moving load.
 - 4.1.5.6.5.2 The load does not contact any obstructions.
- 4.1.5.6.6 Side loading of booms shall be limited to freely suspended loads. Cranes shall not be used for dragging loads sideways.
- 4.1.5.6.7 No hoisting, lowering, swinging, or traveling shall be done while anyone is on the load or hook.
- 4.1.5.6.8 The operator shall not carry loads over people.
- 4.1.5.6.9 On truck-mounted cranes, no loads shall be lifted over the front area except as approved by the crane manufacturer.
- 4.1.5.6.10 The operator shall test the brakes each time a load approaching the rated load is handled by raising it a few cm and applying the brakes.
- 4.1.5.6.11 Outriggers shall be used when the load to be handled a: that particular radius exceeds the rated load without outriggers as given by the manufacturer for that crane. Where floats are used they shall be securely attached to the outriggers. Wood blocks used to support outriggers shall:
 - Be strong enough to prevent crushing;
 - Be free from defects;
 - Be of sufficient width and length to prevent shifting or toppling under load.
- 4.1.5.6.12 Neither the load nor the boom shall be lowered below the point where less than two full wraps of rope remain on their respective drums.

- 4.1.5.6.13 Before lifting loads with locomotive cranes without using outriggers, means shall be applied to prevent the load from being carried by the truck springs.
- 4.1.5.6.14 When two or more cranes are used to lift one load, one designated person shall be responsible for the operation. He shall be required to analyze the operation and instruct all personnel involved in the proper positioning, rigging of the load, and the movements to be made.
- 4.1.5.6.15 In transit the following additional precautions shall be exercised:
 - 4.1.5.6.15.1 The boom shall be carried in line with the direction of motion.
 - 4.1.5.6.15.2 The superstructure shall be secured against rotation, except when negotiating turns when there is an operator in the cab or the boom is supported on a dolly.
 - 4.1.5.6.15.3 The empty hook shall be lashed or otherwise restrained so that it cannot swing freely.
- 4.1.5.6.16 A designated and qualified person shall be responsible for determining and controlling safety before moving a load crane. Decisions such as position of load, boom location, ground support, travel route, and speed of movement shall be in accord with his determinations.
- 4.1.5.6.17 A crane with or without load shall not be moved with the boom so high that it may bounce back over the cab.
- 4.1.5.6.18 When rotating the crane, sudden starts and stops shall be avoided. Rotational speed shall be such that the load does not swing out beyond the radii at which it can be controlled. A tag or restraint line shall be used when rotation of the load is hazardous.
- 4.1.5.6.19 The boom-hoist pawl or other positive locking device shall be engaged when a crane is to be operated at a fixed radius.
- 4.1.5.6.20 Ropes shall not be handled on a winch head without the knowledge of the operator.
- 4.1.5.6.21 While a winch head is being used, the operator shall be within convenient reach of the power unit control level.
- 4.1.5.6.22 See Figure 2 for standard hand signals between crane operator and hook handler.
- 4.1.5.6.23 The operator shall not be permitted to leave his position at the controls while the load is suspended.
- 4.1.5.6.24 No person shall be permitted to stand or pass under a load on the hook.
- 4.1.5.6.25 If the load must remain suspended for any considerable length of time, the operator shall hold the drum from rotating in the lowering direction by activating the positive controllable means of the operator's station.
- 4.1.5.7 Other Requirements
 - 4.1.5.7.1 Rail clamps shall not be used as a means of restraining tipping of a locomotive crane.

- 4.1.5.7.2 Cranes shall not be operated without the full amount of any ballast or counterweight in place as specified by the maker. The ballast or counterweight in place specified by the manufacturer shall not be exceeded.
- 4.1.5.7.3 Necessary clothing and personal belongings shall be stored in such a manner as to not interfere with access or operation.
- 4.1.5.7.4 Tools, oil cans, waste, extra fuses, and other necessary articles shall be stored in the tool box, and shall not be permitted to oie loose in or about the cab.
- 4.1.5.7.5 Refueling. Machines shall not be refueled with the engine running. Spillage of fuel shall be carefully washed away and the fuel tank cap replaced before starting engine.
- 4.1.5.7.6 A carbon dioxide, dry chemical, or equivalent fire extinguisher shall be kept in a cab. Operating and maintenance personnel shall be made familiar with the use and care of the fire extinguishers.
- 4.1.5.7.7 A locomotive crane shall not be swung into a position where railway cars on an adjacent track might strike it, until it has been ascertained that cars are not being moved on the adjacent track and proper flag protection has been established.
- 4.1.5.8 Operating Near Electric Power Lines
 - 4.1.5.8.1 Except where the electrical distribution and transmission lines have been deenergized and visibly grounded at point of work or where insulating barriers not apart of or an attachment to the crane have been erected to prevent physical contact with the lines, cranes shall be operated proximate to, under, over, by, or near powerlines only in accordance with the following:

Figure (2) Sheet 1
Standard Hand Signals for Communication
for Crane Operation

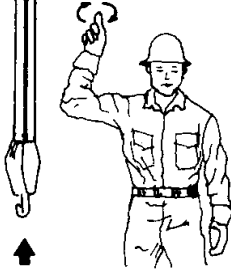
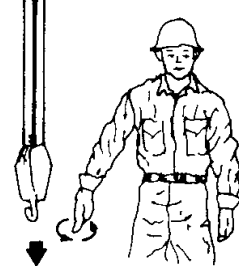
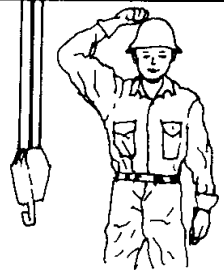
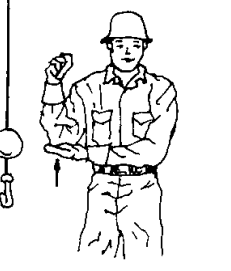
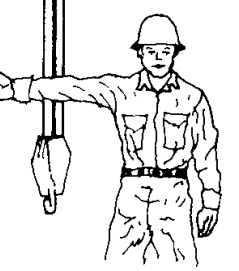
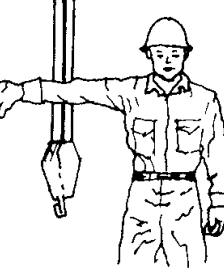
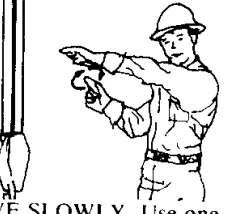
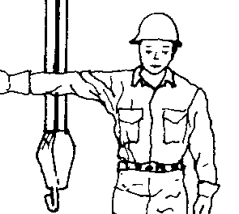
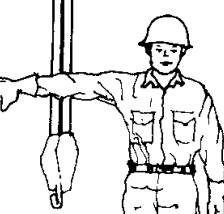
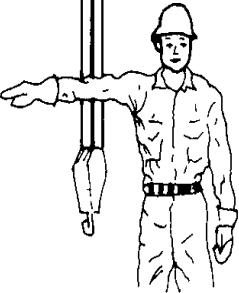
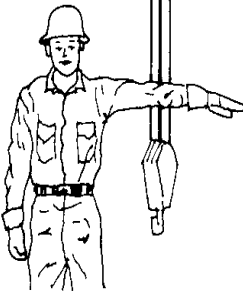
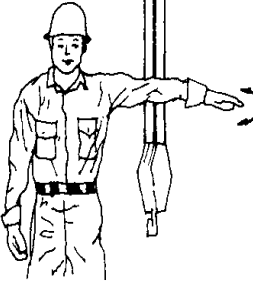
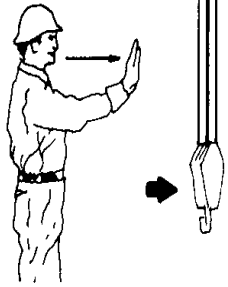
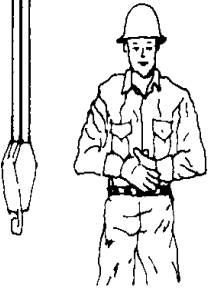
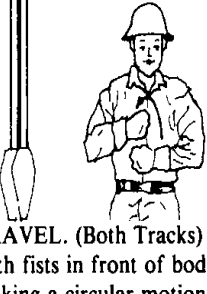
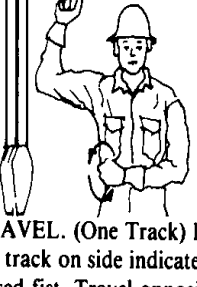
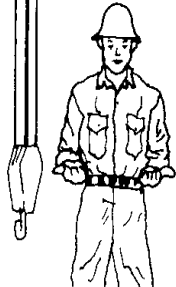
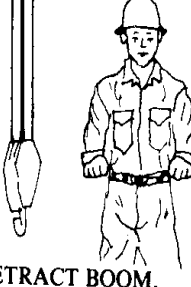
 <p>HOIST. With forearm vertical forefinger pointing up, move hand in small horizontal circle.</p>	 <p>LOWER. With arm extended downward, forefinger pointing down, move hand in small horizontal circles.</p>	 <p>USE MAIN HOIST. Tap fist on head, then use regular signals.</p>
 <p>USE WHIPLINE. (Auxiliary Hoist) Tap elbow with one hand; then use regular signals.</p>	 <p>RAISE BOOM. Arm extended, fingers closed, thumb pointing upward.</p>	 <p>LOWER BOOM. Arm extended, fingers closed, thumb pointing downward.</p>
 <p>MOVE SLOWLY. Use one hand to give any motion signal and place other hand motionless in front of hand giving the motion signal, (Hoist slowly shown in example).</p>	 <p>RAISE THE BOOM AND LOWER THE LOAD. With arm extended, thumb pointing up, flex fingers in and out as long as load movement is desired.</p>	 <p>LOWER THE BOOM AND RAISE THE LOAD. With the arm extended, thumb pointing down, flex fingers in and out as long as load movement is desired.</p>

Figure (2) Sheet 2
Standard Hand Signals for Communication
for Crane Operation

 <p>SWING. Arm extended point with finger in direction of swing of boom.</p>	 <p>STOP. Arm extended, palm down, hold position rigidly.</p>	 <p>EMERGENCY STOP. Arm extended, palm down, move hand rapidly right and left.</p>
 <p>TRAVEL. Arm extended forward, hand open and slightly raised make pushing motion in direction of travel.</p>	 <p>DOG EVERYTHING. Clasp hands in front of body.</p>	 <p>TRAVEL. (Both Tracks) Use both fists in front of body, making a circular motion about each other, indicating direction of travel: forward or backward, (For crawler cranes only).</p>
 <p>TRAVEL. (One Track) lock the track on side indicated by raised fist. Travel opposite track in direction indicated by circular motion of other fist, rotated vertically in front of body.</p>	 <p>EXTENDED BOOM: (Telescoping Booms) Both fists in front of body with thumbs pointing outward.</p>	 <p>RETRACT BOOM. (Telescoping Booms) Both fists in front of body with thumbs pointing toward each other.</p>

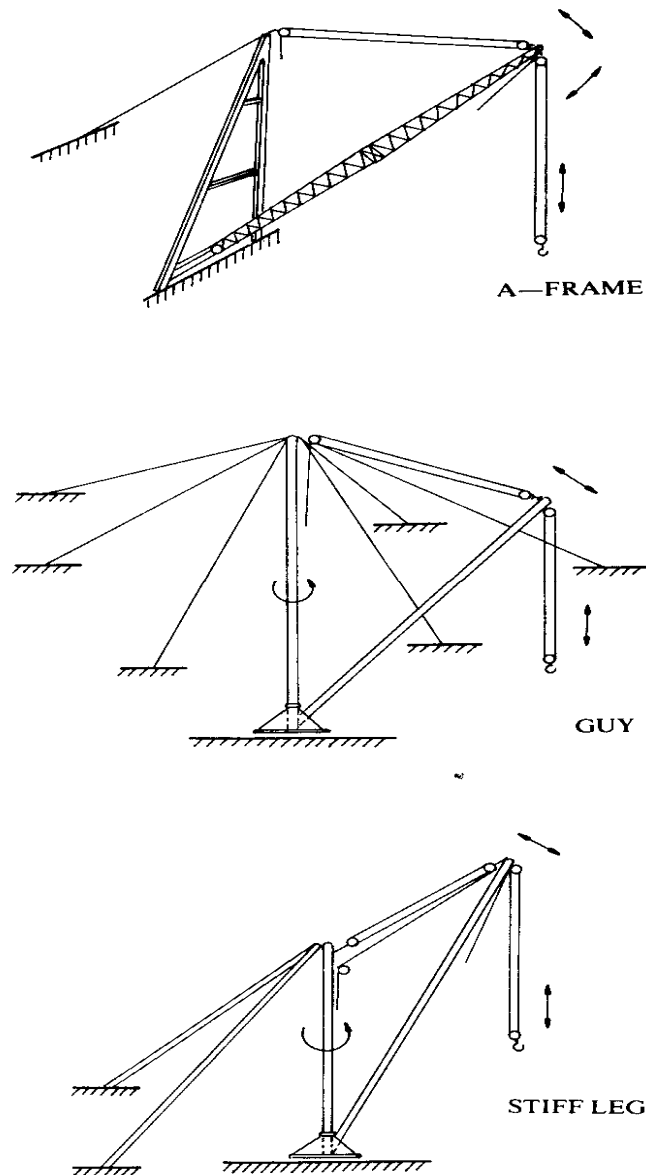
- 4.1.5.8.1.1 For lines rated 50 kv or below, minimum clearance between the lines and any part of the crane or load all be 3m.
- 4.1.5.8.1.2 For lines rated over 50 kv minimum, clearance between the lines and any part of the crane or load shall be 3m plus 1 cm for each 1 kv over 50 kv, or twice the length of the line insulator but never less than 3m.
- 4.1.5.8.1.3 In transit with no load and boom lowered the clearance shall be a minimum of 1.2 m.
- 4.1.5.8.2 Cage-type boom guards insulating links, or proximity warning devices may be used on cranes, but the use of such devices shall not operate to alter the requirements of 4.1.5.8. 1.
- 4.1.5.8.3 Before the commencement of operations near electrical lines, the owners of the lines or their authorized representative shall be notified and provided with all pertinent information.
- 4.1.5.8.4 Any overhead wire shall be considered to be an energized line unless and until the person owning such line or the electrical utility authorities indicate that it is not an energized line.
- 4.1.6 Derricks
 - 4.1.6.1 General
 - 4.1.6.1.1 All derricks shall meet the design specifications as listed in this subparagraph.
 - 4.1.6.1.2 Only designated personnel shall be permitted to operate a derrick.
 - 4.1.6.2 Load ratings
 - 4.1.6.2.1 Rated Load Marking. For permanently installed derricks with fixed lengths of boom, guy, and mast, a substantial, durable, and clearly legible rating chart shall be provided with each derrick and securely affixed where it is visible to personnel responsible for the safe operation of the equipment. The chart shall include the following data:
 - 4.1.6.2.1.1 Manufacturer's approved load ratings at corresponding range of boom angle or operating radii.
 - 4.1.6.2.1.2 Specific lengths of components on which the load ratings are based.
 - 4.1.6.2.1.3 Required parts for hoist reeving. Size and construction of rope may be shown either on the rating chart or in the operating manual.
 - 4.1.6.3 Inspection
 - 4.1.6.3.1 Prior to initial use all new and altered derricks shall be inspected to insure compliance with the provisions of this subparagraph.

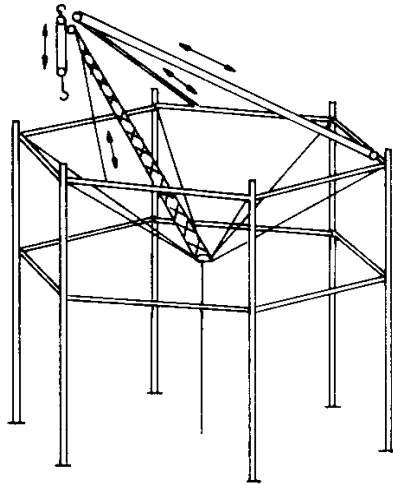
Inspection procedure for derricks in regular service is divided into two general classifications based upon the intervals at which inspection should be performed. The intervals in turn are dependent upon the nature of the critical components of the derrick and the degree of their exposure to wear, deterioration, or malfunction. The two general classifications are herein designated as frequent and periodic with respective intervals between inspections as defined below:

Frequent inspection -- daily to monthly intervals.

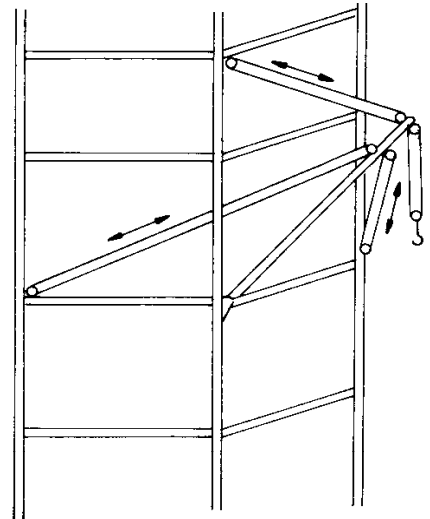
Periodic inspection -- 1 to 12 - month intervals, or as specified by the manufacturer.

Figure 3

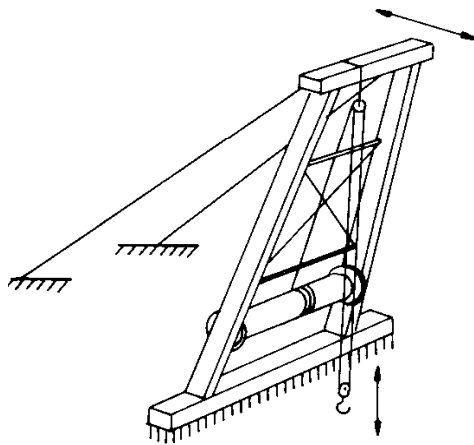




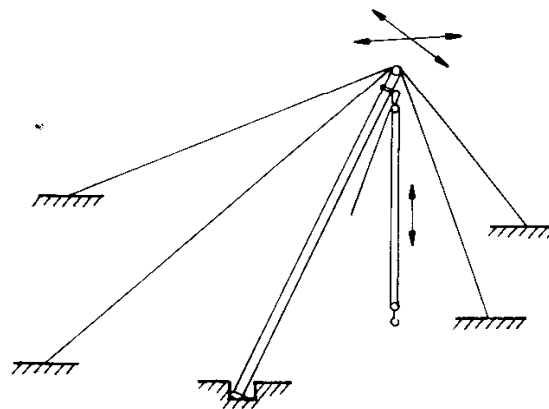
BASKET



CHICAGO BOOM



BREAST



GIN POLE

Figure 4

- 4.1.6.3.2 Items such as the following shall be inspected for defects at intervals as defined in 4.1.6.3.1, including observation during operation for any defects which might appear between regular inspections. Deficiencies shall be carefully examined for any safety hazard:
 - 4.1.6.3.2.1 All control mechanisms: Inspect daily for adjustment, wear, and lubrication.
 - 4.1.6.3.2.2 All chords and lacing: Inspect daily, visually.
 - 4.1.6.3.2.3 Tension in guys: Daily.
 - 4.1.6.3.2.4 Plumb of the mast.
 - 4.1.6.3.2.5 Deterioration or leakage in air or hydraulic systems: Daily.
 - 4.1.6.3.2.6 Derrick hooks with deformations or cracks are prohibited.
 - 4.1.6.3.2.7 Rope reeving; visual inspection for noncompliance with derrick manufacturer's recommendations.
 - 4.1.6.3.2.8 Hoist brakes, clutches, and operating levers: check daily for proper functioning before beginning operations.
 - 4.1.6.3.2.9 Electrical apparatus for malfunctioning, signs of excessive deterioration, dirt, and moisture accumulation.
- 4.1.6.3.3 Complete inspections of the derrick shall be performed at intervals as generally defined in 4.1.6.3.1. These inspections shall include the requirements of 4.1.6.3.2 and in addition, items such as the following, (Deficiencies shall be carefully examined and corrected if faulty):
 - 4.1.6.3.3.1 Structural members for deformations, cracks, and corrosion.
 - 4.1.6.3.3.2 Bolts or rivets for tightness.
 - 4.1.6.3.3.3 Parts such as pins, bearings, shafts, gears, sheaves, drums, rollers, locking and clamping devices, for wear, cracks, and distortion. Worn out, cracked and distorted parts shall be replaced.
 - 4.1.6.3.3.4 Gudgeon pin for cracks, wear, and distortion each time the derrick is to be erected. Worn out or cracked pins shall be replaced.
 - 4.1.6.3.3.5 Powerplants for proper performance and compliance with applicable safety requirements.
 - 4.1.6.3.3.6 Hooks, magnetic particles or other suitable crack detecting inspection should be performed at least once each year.
 - 4.1.6.3.3.7 Foundation or supports shall be inspected for continued ability to sustain the imposed loads.
- 4.1.6.3.4 A derrick which has been idle for a period of 1 month or more, but less than 6 months, shall be given an inspection conforming with requirements of items 4.1.6.3.2 and 4.1.6.6.3 before placing in service.
- 4.1.6.3.5 Standby derricks shall be inspected at least semiannually in accordance with requirements of items 4.1.6.3.2 and 4.1.6.6.3.
- 4.1.6.4 Testing

- 4.1.6.4.1 Prior to initial use all new and altered derricks shall be tested to insure compliance with this subparagraph including the following functions:
 - 4.1.6.4.1.1 Load hoisting and lowering.
 - 4.1.6.4.1.2 Boom up and down.
 - 4.1.6.4.1.3 Swing.
 - 4.1.6.4.1.4 Operation of clutches and brakes of hoist.
- 4.1.6.4.2 All anchorage shall be approved by the appointed person.
- 4.1.6.5 Maintenance
 - 4.1.6.5.1 A preventive maintenance program shall be established.
 - 4.1.6.5.2 Before adjustments and repairs are started on a derrick the following precautions shall be taken:
 - 4.1.6.5.2.1 The derrick to be repaired shall be arranged so it will cause the least interference with other equipment and operations in the area.
 - 4.1.6.5.2.2 All hoist drum dogs shall be engaged.
 - 4.1.6.5.2.3 The main or emergency switch shall be locked in the open position, if an electric hoist is used.
 - 4.1.6.5.2.4 Warning or out of order signs shall be placed on the derrick and hoist.
 - 4.1.6.5.2.5 The repairs of booms or derricks shall either be made when the booms are lowered and adequately supported or safely tied off.
 - 4.1.6.5.2.6 A communication system shall be set up between the hoist operator and the appointed individual in charge of derrick operations before any work on the equipment is started.
 - 4.1.6.5.2.7 After adjustments and repairs have been made the derrick shall not be operated until all guards have been reinstalled, safety devices reactivated, and maintenance equipment removed.
 - 4.1.6.5.3 Adjustments shall be maintained to assure correct functioning of components. Repairs or replacements shall be provided promptly as needed for safe operation. The following are examples of conditions requiring prompt repair or replacement:
 - 4.1.6.5.3.1 Hooks showing defects described in 4.1.6.3.2.6 shall be discarded.
 - 4.1.6.5.3.2 All critical parts which are cracked, broken, bent, or excessively worn out.
 - 4.1.6.5.3.3 All replacement and repaired parts shall have at least the original safety factor.
- 4.1.6.6 Rope Inspection
 - 4.1.6.6.1 A thorough inspection of all ropes in use shall be made at least once a month and a full written, dated, and signed report of rope condition kept on file will be readily available. Any deterioration or damage shall prohibit further use of the rope hazard:
 - 4.1.6.6.1.1 Reduction of rope diameter below nominal diameter due to loss of core support, internal or external corrosion, or wear of outside wires.

- 4.1.6.6.1.2 A number of broken outside wires and the degree of distribution of concentration of such broken wires.
- 4.1.6.6.1.3 Worn outside wires.
- 4.1.6.6.1.4 Corroded or broken wires at end connections.
- 4.1.6.6.1.5 Corroded, cracked, bent, worn out, or improperly applied end connections.
- 4.1.6.6.1.6 Severe kinking, crushing, cutting, or unstranding.
- 4.1.6.6.2 Heavy wear and/or broken wires may occur in sections in contact with equalizer sheaves or other sheaves where rope travel is limited, or with saddles. Particular care shall be taken to inspect ropes at these locations.
- 4.1.6.6.3 All the rope which has been idle for a period of one month or more due to shutdown or storage of a derrick on which it is installed shall be given a thorough inspection before it is placed in service. This inspection shall be for all types of deterioration. A written and dated report of the rope condition shall be available.
- 4.1.6.6.4 Particular care shall be taken in the inspection of nonrotating rope.
- 4.1.6.7 Operations of Derricks
 - Derrick operations shall be directed only by the individual specifically designated for that purpose.
- 4.1.6.8 Operation
 - 4.1.6.8.1 No derrick shall be loaded beyond the rated load. When loads approach the maximum rating of the derrick, it shall be ascertained that the weight of the load has been determined within ± 10 percent before it is lifted.
 - 4.1.6.8.2 The hoist rope shall not be wrapped around the load. The load shall be attached to the hook by means of slings or other suitable devices.
 - 4.1.6.8.3 The load shall be well secured and properly balanced in the sling or lifting device before it is lifted more than a few cm. Before starting to hoist, the following conditions shall be noted:
 - 4.1.6.8.3.1 Hoist rope shall not be kinked.
 - 4.1.6.8.3.2 Multiple part lines shall not be twisted around each other.
 - 4.1.6.8.3.3 The hook shall be brought over the load in such a manner as to prevent swinging.
 - 4.1.6.8.3.4 If there is a slack rope condition, it should be determined that the rope is properly seated on the drum and in the sheaves.
 - 4.1.6.8.3.5 During hoisting, care shall be taken that there is no sudden acceleration or deceleration of the moving load and that the load does not contact any obstructions.
 - 4.1.6.8.3.6 A derrick shall not be used for side loading except when specifically authorized by a responsible person who has determined that the various structural components will not be overstressed.

- 4.1.6.8.3.7 No hoisting, lowering, or swinging shall be done while anyone is on the load or hook.
- 4.1.6.8.3.8 The operator shall avoid carrying loads over people.
- 4.1.6.8.3.9 The operator shall test the brakes each time a load (approaching the rated load) is handled by raising it a few cm and applying the brakes.
- 4.1.6.8.3.10 Neither the load nor boom shall be lowered below the point where less than two full wraps of rope remain on their respective drums.
- 4.1.6.8.3.11 When rotating a derrick, sudden starts and stops shall be prohibited. Rotational speed shall be such that the load does not swing out beyond the radius at which it can be controlled.
- 4.1.6.8.3.12 Boom and hoisting rope systems shall not be twisted.
- 4.1.6.8.4 The operator shall not be allowed to leave his position at the controls while the load is suspended.
- 4.1.6.8.5 People should not be permitted to stand or pass under a load on the hook.
- 4.1.6.8.6 If the load must remain suspended for any considerable length of time, a dog, or pawl and ratchet, or other equivalent means, rather than the brake alone, shall be used to hold the load.
- 4.1.6.8.7 Ropes shall not be handled on a winch head without the knowledge of the operator. While a winch head is being used, the operator shall be within convenient reach of the power unit control lever.
- 4.1.6.8.8 Dogs, pawls, or other positive holding mechanism on the hoist shall be engaged. When not in use, the derrick boom shall:
 - Be laid down;
 - Be secured to a stationary member, as nearly under the head as possible, by attachment of a sling to the load block; or
 - Be hoisted to a vertical position and secured to the mast.
- 4.1.6.9 Other Requirements
 - 4.1.6.9.1 Exposed moving parts, such as gears, ropes, setscrews, projecting keys, chains, chain sprockets, and reciprocating components, which constitute a hazard under normal operating conditions shall be guarded.
 - 4.1.6.9.2 Guards shall be securely fastened. Each guard shall be capable of supporting without permanent distortion, the weight of a 90 kg person unless the guard is located where it is impossible for a person to step on it.
 - 4.1.6.9.3 Hooks shall meet the manufacturer's recommendations and shall not be overloaded. Safety latch type hooks shall be used everywhere possible.
 - 4.1.6.9.4 A carbon dioxide, dry chemical, or equivalent fire extinguisher shall be kept in the immediate vicinity of the derrick. Operating and maintenance personnel shall be familiar with the use and care of the fire extinguishers.

- 4.1.6.9.5 Machines shall not be refueled with the engine running. Spillage of oil or fuel shall be carefully washed away and the fuel tank cap replaced before starting engine.
- 4.1.6.9.6 Except where the electrical distribution and transmission lines have been deenergized and visibly grounded at point of work or where insulating barriers not a part of or an attachment to the derrick have been erected to prevent physical contact with the lines, derricks shall be operated proximate to, under, over, by or near powerlines only in accordance with the following:
 - 4.1.6.9.6.1 For lines rated 50 kv, minimum clearance between the lines and any part of the derrick or load shall be 3m.
 - 4.1.6.9.6.2 For lines rated over 50 kv, minimum clearance between the lines and any part of the derrick or load shall be 3m plus 1 cm for each 1 kv over 50 kv or use twice the length of the line insulator, but never less than 3m.
 - 4.1.6.9.6.3 Cage-type boom guards, insulating links or proximity warning devices may be used on derricks, but the use of such devices shall not operate to alter the requirements of this subparagraph.
 - 4.1.6.9.6.4 Before the commencement of operations near electrical lines, the owners of the lines or their authorized representatives shall be notified and provided with all pertinent information.
 - 4.1.6.9.6.5 Any overhead wire shall be considered to be an energized line until the owner of the line or their authorized representatives state that it is deenergized.
 - 4.1.6.9.6.6 Necessary clothing and personnel belongings shall be stored in such a manner as to not interfere with access or operation.
 - 4.1.6.9.6.7 Tools, oilcans, waste, extra fuses, and other necessary articles shall be stored in the toolbox, and shall not be permitted to lie loose in or about the cab or operating enclosure.
- 4.1.7 Slings
 - 4.1.7.1 Operations
 - 4.1.7.1.1 Slings that are damaged or defective shall not be used.
 - 4.1.7.1.2 Slings shall not be shortened with knots or bolts or other makeshift devices.
 - 4.1.7.1.3 Sling legs shall not be kinked.
 - 4.1.7.1.4 Slings shall not be loaded in excess of their rated capacities which shall have a safety factor of 5.
 - 4.1.7.1.5 Slings used in a basket hitch shall have the loads balanced to prevent slippage.
 - 4.1.7.1.6 Slings shall be securely attached to their loads.
 - 4.1.7.1.7 Slings shall be padded or protected from the sharp edges of their loads.
 - 4.1.7.1.8 Suspended loads shall be kept clear of all obstructions.
 - 4.1.7.1.9 All employees shall be kept clear of loads about to be lifted and of suspended loads.

- 4.1.7.1.10 Hands or fingers shall not be placed between the sling and its load while the sling is being tightened around the load.
- 4.1.7.1.11 Shock loading is prohibited.

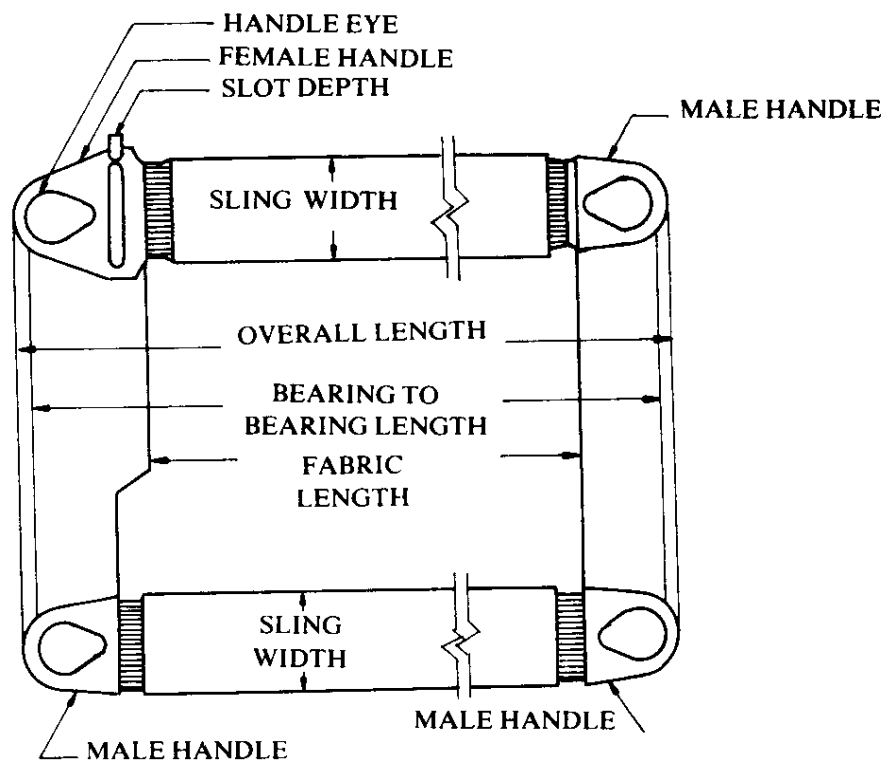


Figure 5
Metal Mesh Sling (Typical).

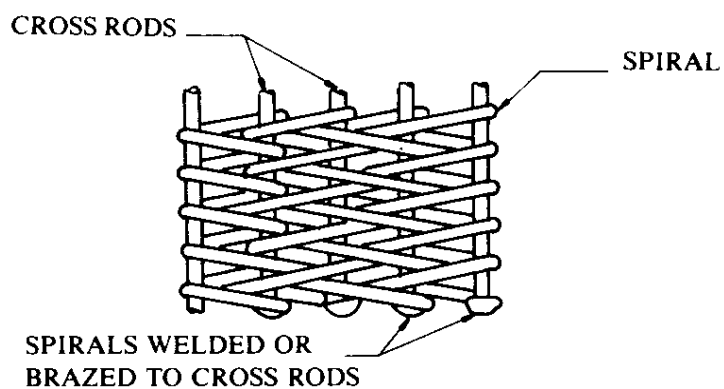


Figure 6
Metal Mesh Construction.

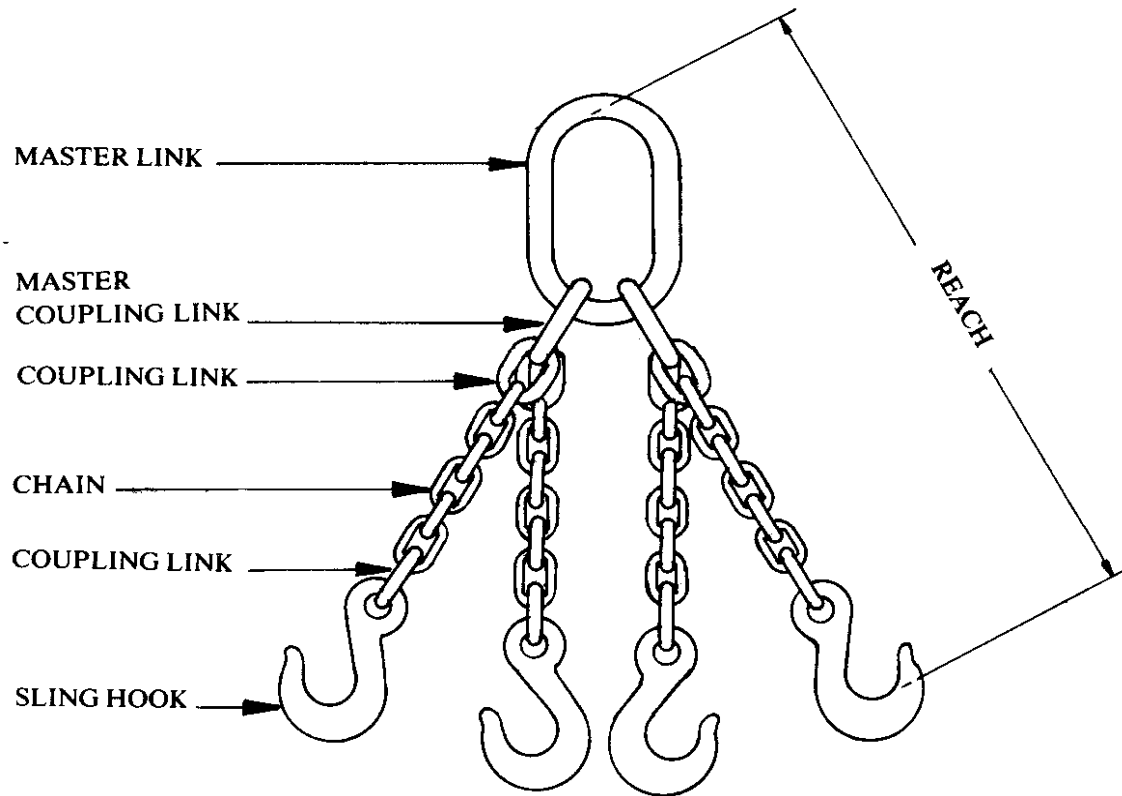
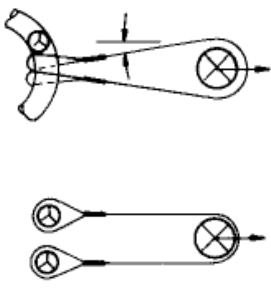

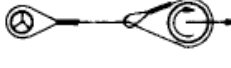
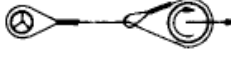


Figure 7
Major Components of a Quadruple Sling.

Figure 8
Basic Sling Configurations With Vertical Legs.

FORM OF HITCH		KIND OF SLING
BASKET HITCH (ALTERNATES HAVE IDENTICAL LOAD RATINGS)	CHOKER HITCH	
 	 	EYE & EYE
		ENDLESS

Notes: Angle 5° or less from the vertical may be considered vertical angles.

For slings with legs more than 5° off vertical, the actual angle as shown in Figure 9 must be considered.

Explanation of Symbols: Minimum Diameter of Curvature.



Represents a contact surface which shall have a diameter of curvature at least double the diameter of the rope from which the sling is made.



Represents a contact surface which shall have a diameter of curvature at least 8 times the diameter of the rope.



Represents a load in a choker hitch and illustrates the rotary force on a load and/or the slippage of the rope in contact with the load. Diameter of curvature of load surface shall be at least double the diameter of the rope.

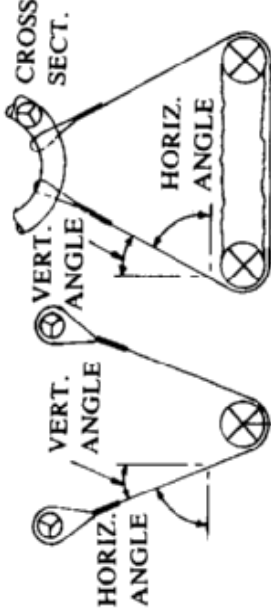
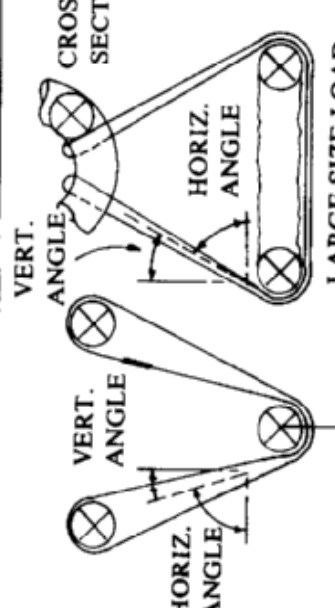
FORM OF HITCH			
VERTICAL HITCH	CHOKER HITCH	BASKET HITCH	
NOT APPLICABLE	NOT APPLICABLE		
NOT APPLICABLE	NOT APPLICABLE		
KIND OF SLING		EYE & EYE	ENDLESS

Figure 9

Sling Configurations with Angled Legs

Notes: For vertical angles of 5° or less, refer to Figure 8, «Basic Sling Configurations with Vertical Legs». See Figure 8 for explanation of symbols.

4.1.7.1.12 A sling shall not be pulled from under a load when the load is resting on the sling.

4.1.7.2 Inspections

Each day before being used, the sling and all fastenings and attachments shall be inspected for damage or defects by a competent person designated by the employer. Damaged or defective slings shall be immediately removed from service.

4.1.7.3 Alloy Steel Chain Slings

- 4.1.7.3.1 Alloy steel chain slings shall have permanently affixed durable identification stating size, grade, rated capacity, and reach.
- 4.1.7.3.2 Hooks, rings, oblong links, pear shaped links, welded or mechanical coupling links or other attachments shall have a rated capacity at least equal to that of the alloy steel chain with which they are used or the sling shall not be used in excess of the rated capacity of the weakest component.
- 4.1.7.3.3 Makeshift links or fasteners formed from bolts or rods, or other such attachments, shall not be used.
- 4.1.7.3.4 In addition to the inspection required by 4.1.7.2 thorough periodic inspection of slings in use shall be made on a regular basis, to be determined on the basis of:
Frequency of sling use;
Severity of service conditions;
Nature of lifts being made; and
Experience gained on the service life of slings used in similar circumstances.
Such inspections shall in no event be at intervals greater than one every 12 months.
- 4.1.7.3.5 The employer shall make and maintain a record of the most recent month in which each sling was thoroughly inspected, and shall make such record available for examination. The thorough inspection of slings shall be performed by a competent person designated by the employer, and shall include a thorough inspection for wear, defective welds, deformation and increase in length. Where such defects or deterioration are present, the sling shall be immediately removed from service.
- 4.1.7.3.6 The employer shall ensure that before use, each new, repaired, or reconditioned sling, including all welded components in the sling assembly, shall be proof tested by the sling manufacturer. The employer shall retain a certificate of the proof test and shall make it available for examination.
- 4.1.7.3.7 Slings shall be permanently removed from service if they are heated above 50°C. When exposed to service temperatures in excess of 315°C maximum working load limits shall be reduced in accordance with the chain of sling manufacturer's recommendations.
- 4.1.7.3.8 When welding or heat testing is performed, slings shall not be used unless repaired, reconditioned and proof tested by the sling manufacturer or an equivalent entity. Mechanical coupling links or low carbon steel repair links shall not be used to repair broken lengths of chain.
- 4.1.7.3.9 If the chain size at any point of any links is less than 80% of the original size, the sling shall be removed from service. See Figure 7.
- 4.1.7.3.10 Slings with cracked or deformed master links, coupling links or other components shall be removed from service. Slings shall be removed from service if hooks are cracked, have been opened more than 15 percent of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.

- 4.1.7.4 Wire Rope Slings
 - 4.1.7.4.1 Cable slings shall have a minimum clear length of wire rope 10 times the component rope diameter between splices, sleeves or end fittings.
 - 4.1.7.4.2 Braided slings shall have a minimum clear length of wire rope 40 times the component rope diameter between the loops or end fittings.
 - 4.1.7.4.3 Cable laid grommets, strand laid grommets and endless slings shall have a minimum circumferential length of 96 times their body diameter.
 - 4.1.7.4.4 Fiber core wire rope slings of all grades shall be permanently removed from service if they are exposed to temperatures in excess of 90°C.
 - 4.1.7.4.5 When nonfiber core wire rope slings of any grade are used at temperatures above 200°C or below minus 65°C, recommendations of the sling manufacturer regarding use at these temperatures shall be followed.
 - 4.1.7.4.6 Welding of end attachments, except covers to thimbles, shall be performed prior to the assembly of the sling.
 - 4.1.7.4.7 All welded end attachments shall not be used unless proof tested by the manufacturer or an equivalent entity at twice their rated capacity. The employer shall retain a certificate of the proof test, and make it available for examination.
 - 4.1.7.4.8 Wire rope slings shall be immediately removed from service if any of the following conditions are present:
 - 4.1.7.4.8.1 Ten randomly distributed broken wires in one rope lay, or five broken wires in one strand in one rope lay.
 - 4.1.7.4.8.2 Wear or scraping of one-third the original diameter of outside individual wires.
 - 4.1.7.4.8.3 Kinking, crushing, bird caging or any other damage resulting in distortion of the wire rope structure.
 - 4.1.7.4.8.4 Evidence of heat damage.
 - 4.1.7.4.8.5 End attachments that are cracked, deformed or worn out.
 - 4.1.7.4.8.6 Hooks that have been opened more than 15 Percent of the normal throat opening measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook.
 - 4.1.7.4.8.7 Corrosion of the rope or end attachments,
- 4.1.7.5 Metal Mesh Slings
 - 4.1.7.5.1 Each metal mesh sling shall have permanently affixed to it a durable marking that states the rated capacity for vertical, basket hitch and choker hitch loadings. See Figures 8 and 9.
 - 4.1.7.5.2 Handles shall have a rated capacity at least equal to the metal fabric and exhibit no deformation after proof testing.
 - 4.1.7.5.3 The fabric and handles shall be jointed so that:
 - 4.1.7.5.3.1 The rated capacity of the sling is not reduced;

- 4.1.7.5.3.2 The load is evenly distributed across the width of the fabric;
- 4.1.7.5.3.3 Sharp edges will not damage the fabric.
- 4.1.7.5.4 Coatings which diminish the rated capacity of a sling shall not be applied.
- 4.1.7.5.5 All new and repaired metal mesh slings, including handles, shall not be used unless proof tested by the manufacturer or an equivalent entity at a minimum of 1-1 /2 times their rated capacity. Elastomer impregnated slings shall be proof tested before coating.
- 4.1.7.5.6 Metal mesh slings which are not impregnated with elastomers may be used in a temperature range from minus 30°C to plus 290°C without decreasing the working load limit. Metal mesh slings impregnated with polyvinyl chloride or neoprene may be used only in temperature range from minus 18°C to plus 90°C. For operations outside these temperature ranges or for metal mesh slings impregnated with other materials, the sling manufacturer's recommendation shall be followed.
- 4.1.7.5.7 Metal mesh slings which are repaired shall not be used unless repaired by a metal mesh sling manufacturer. Once repaired, each sling shall be permanently marked or tagged, or a written record maintained, to indicate the date and nature of the repairs and the person or organization that performed the repairs. Records of repairs shall be made available for examination.
- 4.1.7.5.8 Removal From Service. Metal mesh slings shall be immediately removed from service if any of the following conditions are present:
 - 4.1.7.5.8.1 A broken weld or broken brazed joint along the sling edge;
 - 4.1.7.5.8.2 Reduction in wire diameter of 25 percent due to abrasion or 1 5 percent due to corrosion;
 - 4.1.7.5.8.3 Lack of flexibility due to distortion of the fabric;
 - 4.1.7.5.8.4 Distortion of the female handle so that the depth of the slot is increased more than 10 percent;
 - 4.1.7.5.8.5 Distortion of either handle so that the width of the eye is decreased more than 10 percent;
 - 4.1.7.5.8.6 A 15 Percent reduction of the original cross sectional area of metal at any point around the handle eye;
 - 4.1.7.5.8.7 Distortion of either handle out of its plane.
- 4.1.7.6 Natural and Synthetic Fiber Rope Slings
 - 4.1.7.6.1 Natural and synthetic fiber rope slings, except for wet frozen slings, may be used in a temperature range from minus 30°C to plus 80°C without decreasing the work load limit. For operations outside this temperature range and for wet frozen slings, the sling manufacturer's recommendations shall be followed.
 - 4.1.7.6.2 Spliced fiber rope slings shall not be used unless they have been spliced in accordance with recommendations of the manufacturer.

- 4.1.7.6.2.1 In manila rope, eye splices shag consist of at least three full tucks, and short splices shall consist of at least 6 full tucks, 3 on each side of the splice center line.
- 4.1.7.6.2.2 In synthetic fiber rope, eye splices shall consist of at least 4 full tucks, and short splices shall consist of at least 8 full tucks, 4 on each side of the center line.
- 4.1.7.6.2.3 Strand end tails shall not be trimmed flush with the surface of the rope immediately adjacent to the full tucks. This applies to all types of fiber rope and both eye and short splices. For fiber rope under 25 mm in diameter, the tail shall project at least 6 rope diameters beyond the last full tuck. For fiber rope 25 mm in diameter and larger, the tail shall project at least 150 mm beyond the last full tuck. Where a projecting tail interferes with the use of the sling, the tail shall be tapered and spliced into the body of the rope using at least 2 additional tucks (which will require a tail length of approximately 6 rope diameters beyond the last full tuck).
- 4.1.7.6.2.4 Fiber rope slings shall have a minimum clear length of rope between eye splices equal to 10 times the rope diameter.
- 4.1.7.6.2.5 Knots shall not be used in lieu of splices.
- 4.1.7.6.2.6 Clamps not designed specifically for fiber ropes shall not be used for splicing.
- 4.1.7.6.2.7 For all eye splices, the eye shall be of such size to provide an included angle of not greater than 60 degrees at the splice when the eye is placed over the load or support.
- 4.1.7.6.3 End Attachments. Fiber rope slings shall not be used if end attachments in contact with the rope have sharp edges or projections.
- 4.1.7.6.4 Natural and synthetic fiber rope sling shall be immediately removed from service if any of the following conditions are present:
 - 4.1.7.6.4.1 Abnormal wear;
 - 4.1.7.6.4.2 Powdered fiber between strands;
 - 4.1.7.6.4.3 Broken or cut fibers;
 - 4.1.7.6.4.4 Variations in the size of roundness of strands;
 - 4.1.7.6.4.5 Discoloration or rotting;
 - 4.1.7.6.4.6 Distortion of hardware in the sling.
- 4.1.7.6.5 Only fiber rope slings made from new rope shall be used. Use of repaired or reconditioned fiber rope slings is prohibited.
- 4.1.7.7 Synthetic Web Slings
 - 4.1.7.7.1 Each sling shall be marked or coded to show the rated capacities for each type of hitch and type of synthetic web material.
 - 4.1.7.7.2 Synthetic webbing shall be of uniform thickness and width and selvage edges shall not be split from the webbing's width.
 - 4.1.7.7.3 Fittings shall be:
 - 4.1.7.7.3.1 Of a minimum breaking strength equal to that of the sling; and

- 4.1.7.7.3.2 Free from all sharp edges that could in any way damage the webbing.
- 4.1.7.7.4 Stitching shall be the only method used to attach end fittings to webbing and to form eyes. The thread shall be in an even pattern and contain a sufficient number of stitches to develop the full breaking strength of the sling.
- 4.1.7.7.5 When synthetic web slings are used, the following precautions shall be taken:
 - 4.1.7.7.5.1 Nylon web slings shall not be used where fumes, vapors, sprays, mists or liquids of acids or phenolics are present;
 - 4.1.7.7.5.2 Polyester and polypropylene web slings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present;
 - 4.1.7.7.5.3 Web slings with aluminium fittings shall not be used where fumes, vapors, sprays, mists or liquids of caustics are present.
- 4.1.7.7.6 Synthetic web slings of polyester and nylon shall not be used at temperatures in excess of 80°C. Polypropylene web slings shall not be used at temperatures in excess of 90°C.
- 4.1.7.7.7 Synthetic web slings which are repaired shall not be used unless repaired by a sling manufacturer or an equivalent entity.
- 4.1.7.7.8 Each repaired sling shall be proof tested by the manufacturer or equivalent entity to twice the rated capacity prior to its return to service. The employer shall retain a certificate of the proof test and make it available for examination.
- 4.1.7.7.9 Slings, including webbing and fittings, which have been repaired in a temporary manner shall not be used.
- 4.1.7.7.10 Synthetic web slings shall be immediately removed from service if any of the following conditions are present:
 - Acid or caustic burns;
 - Melting or charring of any part of the sling surface;
 - Snags, punctures, tears or cuts;
 - Broken or worn stitches; or
 - Distortion of fittings.
- 4.1.8 Helicopters
 - 4.1.8.1 Regulations. Helicopter cranes shall comply with any applicable regulations of the GSO .
 - 4.1.8.2 Briefing. Prior to each day's operation a briefing shall be conducted. This briefing shall set forth the plan of operation for the pilot and ground personnel.
 - 4.1.8.3 Slings and Tag Lines. Loads shall be properly slung. Tag lines shall be of a length that will not permit their being drawn up into the rotors. Pressed sleeve, swedged eyes, or equivalent means shall be used for all freely suspended loads to Prevent hand splices from spinning ppen or cable clamps from loosening.
 - 4.1.8.4 Cargo Hooks. All electrically operated cargo books shall have the electrical activating device so designed and installed as to prevent inadvertent operation. In addition, these cargo hooks shall be equipped with an emergency mechanical

control for releasing the load. The employer shall ensure that the hooks are tested prior to each day's operation by a competent person to determine that the release functions properly, both electrically and mechanically.

4.1.8.5 Personal Protective Equipment

4.1.8.5.1 Personal protective equipment shall be provided and used. Personal protective equipment shall consist of complete eye protection and hardhats secured by chin-straps. See Section 5.

4.1.8.5.2 Loose-fitting clothing likely to flap in rotor downwash, and thus be snagged on the hoist line, shall not be worn.

4.1.8.6 Loose Gear and Objects. The employer shall take all necessary precautions to protect employees from flying objects in the rotor downwash. All loose gear within 30 m of the place of lifting the load or depositing the load, or within all other areas susceptible to rotor downwash shall be secured or removed.

4.1.8.7 Housekeeping. Good housekeeping shall be maintained in all helicopter loading and unloading areas.

4.1.8.8 Load Safety. The size and weight of loads, and the manner in which loads are connected to the helicopter shall be checked by the loading supervisor.

4.1.8.9 Hooking and Unloading Loads. When employees perform work under hovering craft, a safe means of access shall be provided for employees to reach the hoist line hook and engage or disengage cargo slings. Employees shall not be permitted to perform work under hovering craft except when necessary to hook or unhook loads.

4.1.8.10 Static Charge. Static charge on the suspended load shall be dissipated with a grounding device before ground personnel touch the suspended load, unless protective rubber gloves are being worn by all ground personnel.

4.1.8.11 Ground Lines. Hoist wires or other gear, except for pulling lines or conductors that are allowed to "pay out" from a container or roll off a reel, shall not be attached to any fixed ground structure, or allowed to foul on any fixed structure.

4.1.8.12 Visibility. Ground personnel shall be instructed and the employer shall ensure that, when visibility is reduced by dust or other conditions, they shall exercise special caution to keep clear of main and stabilizing rotors. Precautions shall also be taken by the employer to eliminate, as far as practical, the dust or other conditions reducing the visibility.

4.1.8.13 Signal Systems. The employer shall instruct the aircrew and ground personnel on the signal systems to be used and shall review the system with the employees in advance of hoisting the load. This applies to both radio and hand signal systems. Hand signals, where used, shall be as shown in Figure 10.

4.1.8.14 Approach Distance. No employee shall be permitted to approach within 15 m of the helicopter when the rotor blades are turning, unless his work duties require his presence in that area.

4.1.8.15 Approaching Helicopter. Whenever approaching or leaving a helicopter which has its blade rotating, all employees shall remain in full view of the pilot and

keep in a crouched position. No employee shall be permitted to work in the area from the cockpit or cabin rearward while blades are rotating, unless authorized by the helicopter operator to work there.

- 4.1.8.16 Communications. There shall be constant reliable communication between the pilot and the designated employee of the ground crew who acts as a signalman during the period of loading and unloading. This signalman shall be clearly distinguishable from other ground personnel.
- 4.1.8.17 Fires. Open fires shall not be permitted in areas where they could be spread by the rotor downwash.

Figure 10 sheet 1
Helicopter Hand Signals



MOVE RIGHT. Left arm extended horizontally; right arm sweeps upward to position over head.



MOVE LEFT. Right arm extended horizontally; left arm sweeps upward to position over head.



MOVE FORWARD. Combination of arm and hand movement in a collection motion pulling toward body.



Figure 10 Sheet 2
Helicopter Hand Signals



HOLD OVER. The single "Hold" is executed by placing arms over head with clenched fists.



TAKEOFF. Right hand behind back; left hand pointing up



LAND. Arms cross in front of body and pointing downward



MOVE UPWARD. Arms extended, palms up; arms sweeping up



MOVE DOWNWARD. Arms extended, palms down; arms sweeping down.

- 4.1.9 Material Hoists
- 4.1.9.1 The employer shall comply with the manufacturer's specifications and limitations applicable to the operation of all hoists. Where manufacturer's specifications are not available, the limitations assigned to the equipment shall be based on the determinations of a professional engineer competent in the field.
- 4.1.9.2 Rated load capacities, recommended operating speeds, and special hazard warnings or instructions shall be posted on cars and platforms.
- 4.1.9.3 Wire rope shall be removed from service when any of the following conditions exists:
- 4.1.9.3.1 In hoisting ropes, 6 randomly distributed broken wires in 1 rope lay or 3 broken wires in 1 strand in 1 rope lay.
- 4.1.9.3.2 Abrasion, scrubbing, flattening, or peenings causing loss of more than 1/3 of the original diameter of the outside wires.
- 4.1.9.3.3 Evidence of any heat damage resulting from a torch or any damage caused by contact with electrical wires.
- 4.1.9.3.4 Reduction from nominal diameter of more than 1.19 mm for diameters up to and including 19 mm; 1.59 mm, for diameters 22.25 mm to 28.56 mm; and 2.38 mm for diameters 31.75 to 38.1 mm.
- 4.1.9.4 Hoisting ropes shall be installed in accordance with the wire rope manufacturer's recommendations.
- 4.1.9.5 The installation of live booms on hoists is prohibited.
- 4.1.9.6 Operating rules shall be established and posted at the operator's station of the hoist. Such rules shall include signal system and allowable line speed for various loads. Rules and notices shall be posted on the car frame or cross-head in a conspicuous location, including the statement "No Riders Allowed".
- 4.1.9.7 No person shall be allowed to ride on material hoists except for the purposes of inspection and maintenance.
- 4.1.9.8 All entrances of the hoistways shall be protected by substantial gates or bars which shall guard the full width of the landing entrance. All hoistway entrance bars and gates shall be painted with diagonal contrasting colors, such as black and yellow stripes.
- 4.1.9.9 Bars shall be not less than 41 by 92 mm wooden bars or the equivalent, located 61 cm from the hoistway line. Bars shall be located not less than 91 cm nor more than 1.1 m above the floor.
- 4.1.9.10 Gates or bars protecting the entrances to hoistways shall be equipped with a latching device.
- 4.1.9.11 Overhead protective covering of 50 mm planking, 19 mm plywood, or other solid material of equivalent strength, shall be provided on the top of every material hoist cage or platform.

- 4.1.9.12 The operator's station of a hoisting machine shall be provided with overhead protection equivalent to tight planking not less than 50 mm thick. The support for the overhead protection shall be of equal strength.
- 4.1.9.13 Hoist towers may be used with or without an enclosure on all sides. However, whichever alternative is chosen, the following applicable conditions shall be met:
 - 4.1.9.13.1 When a hoist tower is enclosed, it shall be enclosed on all sides for its entire height with a screen enclosure of 12.7 mm mesh, 1.2 mm wire or equivalent, except for landing access;
 - 4.1.9.13.2 When a hoist tower is not enclosed, the hoist platform of car shall be totally enclosed (caged) on all sides or the full height between the floor and the overhead protective covering with 12.9 mm mesh of 1.9 mm wire or equivalent. The hoist platform enclosure shall include the required gates for loading and unloading. A 1.8 m high enclosure shall be provided on the unused sides of the hoist tower at ground level.
- 4.1.9.14 Car arresting devices shall be installed to function in case of rope failure.
- 4.1.9.15 All material hoist towers shall be designed by a professional engineer.